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Some Observations on the Fauna of the Maldive Islands

PART I—INTRODUCTION

BY

W. W. A. PHILLIPS

Through the kindness of the Hon. Mr. Ibrahim Ali Didi, Prime Minister of the Maldive Islands, my wife and I were able to spend almost three months studying and collecting the fauna of the Maldivian Archipelago. After having been wrecked on Cassanfaru reef, we arrived in Malé, the capital, on the 30th November 1956 and left during the following February.

Bird-study was the chief object of our visit but mammals, reptiles, amphibians, and many invertebrates were studied and collected as and when opportunities occurred. We were fortunate enough, in this connection, to have attached to us for the duration of our visit as interpreter and guide Mr. Ibrahim Didi, who not only spoke and wrote excellent English but knew the names, localities, and many of the habits of most of the Maldivian birds and also of many other members of the fauna of the atolls. This fact was of immense assistance to us, both in the study of the habits and distribution of each species, as well as in the collecting of specimens. Our work was therefore greatly facilitated. William Perera, our taxidermist/collector, who accompanied us from Colombo, also rendered admirable service and prepared many excellent specimens.

The Maldivian Archipelago, lying between latitude 8° north to 1° south and longitude 72° to 74° east, is composed of a chain (double

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for much of its length) of coral atolls, resting on a submerged mountain range, some 400 miles to the south-west of Ceylon. In the open seas adjacent to the atolls depths of over 2,000 fathoms have been recorded, while within the reefs 20 to 30 fathoms is normal.

The atolls, or groups of islands and reefs which comprise the Archipelago, number 19. They extend from north to south for a distance of nearly 470 miles and are 70 miles across at the widest. Immediately to the north, across the '8 Degree Channel', is Minicoy of light-house fame, and still further north, across the '9 Degree Channel', are the Laccadive Islands, stretching northward almost to the Indian coast. 300/400 miles to the southward of the most southerly atoll, Addu, lies the Chagos Archipelago.

The islands which form the atolls are all quite small and low lying; they are rarely more than 6 feet above sea-level. Some have swampy areas in their interiors, and all have coral reefs around them. Over 2,500 of them have been counted but less than 220 are permanently inhabited. Most of the larger have been planted with coconut palms among the succulent scrub and low undergrowth that flourishes in their coral sands; a few have large evergreen trees, mostly imported, growing round the villages and some of the swamps. Although tropical, climatic conditions are equable being governed by the two monsoons, the south-west blowing from April-August and the north-east from October-February, bringing ample rain and cool winds in their train.

Between 85,000 and 90,000 is the estimated population of the Archipelago. The people depend chiefly upon fishing for a livelihood. Malé, the capital, is in North Malé Atoll, about the centre of the group. It is reputed to have a population of between 8,000 and 9,000, living on an island 1 mile in length by about ½ a mile in breadth.

Owing to difficulties of inter-atoll communications, most of our specimens were taken in or near North Malé Atoll but a few were brought in by fishermen and others from outlying islands in other atolls. The specimens were handed over, on our return to England, to the British Museum (Natural History), where they have been worked out by various members of the scientific staff, to whom our best thanks are due for the extra work involved.

Little collecting has been done in the past in the Maldives, except for marine forms collected by Gardiner during his expeditions. True, he collected a few birds, reptiles, and amphibians, but only casually. So, until our visit, much of the fauna of the Archipelago was unknown.

Speaking generally, there can be no question that the Maldivian fauna as a whole is very closely related to that of the Indian peninsula; in many cases it appears identical, amply supporting the theory that most species have come to the atolls either from India or

Malé, capital of the Maldive Islands, from Hullule Island.

Lankcumfurri—nesting place of Shearwaters. A typical reef-island.

Photos : W. W. A. Phillips

Vegetation on Lankcumfurri Island, amongst which Shearwaters had their nesting burrows.

The beach at Lankcumfurri Island.

Photos : W. W. A. Phillips

from Ceylon in comparatively recent times. Many indeed, such as the rats and shrews, have undoubtedly been imported unintentionally by human agency. Few of the species have been isolated long enough for them to have diverged even subspecifically. There are, however, several exceptions to this rule, notably three species of birds and the Flying Fox (*Pteropus giganteus ariel*) which can be distinguished as indigenous forms.

For the benefit of other workers, it is intended to publish in this series a number of papers drafted by those scientists who have examined the collections. These, it is hoped, will give a clear picture of the type of fauna to be found in the Maldive Islands, where much more collecting and systematic work is required before our knowledge of the fauna can be considered fairly complete.

ACKNOWLEDGEMENTS

Our grateful thanks are due, firstly, to the Hon. Mr. Ibrahim Ali Didi, Prime Minister of the Maldive Islands, who not only made our visit possible but, by his thoughtful kindness during our visit, greatly assisted our work and our comfort; to His Excellency Philip K. Crowe, the American Ambassador to Ceylon, and to Mr. Norman Costar, C.M.G., the Acting High Commissioner, who facilitated our arrangements and contributed in so many ways to our enjoyment; to our many friends in Malé, who made our visit so pleasant, and especially to Mr. Ibrahim Didi who did so much for us and gave us so much information; to Dr. W. E. China, Keeper of Entomology, to Drs. H. W. Parker and F. C. Fraser, Keepers of Zoology, and to Mr. J. D. Macdonald, Deputy Keeper of Zoology, at the British Museum (Natural History) for much help and advice, and to all those who have kindly contributed papers in this series and whose names appear in the headings of the respective papers.

PART II—MAMMALS

BY

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There are few published records of mammals from the Maldive Archipelago. Gardiner (1906), during a survey of the fauna of the Maldive and Laccadive Archipelagos, recorded *Pteropus medius* [=*Pteropus giganteus giganteus* later separated from the Indian Flying Fox under the name *Pteropus ariel* by Allen (1908)], *Suncus* *murinus*, and *Rattus rattus alexandrinus*, the two latter forms almost certainly introduced by man. More recently, Allen (1936) has described *Pteropus hypomelanus maris* from Addu Atoll, a form which is a western outlier of a predominantly Austro-Malayan species. These notes are based on a collection obtained by Major W. W. A. Phillips on the more northerly atolls of the Maldive Archipelago (mainly on Malé) during the period December 1956 to February 1957. The collection includes all the forms previously listed from the Archipelago except *Pteropus hypomelanus maris*, and adds the house mouse, *Mus musculus castaneus*, certainly introduced by man, to the known fauna of this group of islands. Major Phillips also notes that domestic rabbits have been liberated and now run wild on certain of the islands. He encountered no Microchiroptera during his visit to the Archipelago. Major Phillips, who is well known for his work on the mammals of Ceylon, has supplied the Maldivian names of the mammals and has been kind enough to add his field comments to my own remarks on the material. His notes are placed in square parentheses at the end of the systematic matter and are initialled 'W.W.A.P.' All measurements are in millimetres, and are quoted in the form of the minimum and maximum for each series, followed by the arithmetic mean in parentheses.

Suncus murinus caerulescens (Shaw): Musk Shrew

1796 *Sorex pilorides* Shaw, Mus. Lever. **2** :31 (Not of Pallas, 1799, which is indeterminable).
1800 *Sorex caerulescens* Shaw, Gen. Zool. Mamm. **1**:533. India.
1831 *Sorex giganteus* Geoffroy, Voy. Bélanger Indes. Orient. Zool. 117. Bengal.

♂♂ 57.388-389, ♀♀ 57.390-392, juvenile 57.393. Albino specimens, ♂♂ 57.394-395, ♀♀ 57.396-397, juvenile 57.398. Malé Atoll.

Maldivian name: *Hickundi*

Dorsally, the normally coloured specimens of this small series are blue-grey and rarely have the hairs tipped with fawn or brown. In this they differ from specimens of *S. m. murinus* from Madhya Pradesh and Ceylon. [For notes on the latter race see Lindsay (1929) and Phillips (1935) (called *Suncus caeruleus caeruleus* by these authors)]. The underparts are very slightly paler than the back while the whiskers and the hairs of the tail and feet are white or grey-white. The series as a whole averages larger than *S. m. murinus* and in all respects closely resembles specimens from Ceylon referred by Phillips (1935) to *S. m. giganteus* [called *caerulescens* by Ellerman and Morrison-Scott (1951)]. The specimens are accordingly referred to that race, which Phillips observes is common around Colombo and other

Ceylonese seaports, having been introduced from India where it is found in Bombay and at other ports in addition to its natural range in the Darbhanga and Midnapore Districts. It has probably been introduced to Malé through the agency of the dhows that ply between that atoll and the western ports of Ceylon. Phillips (1935) notes that albino or semi-albino specimens of this shrew are 'not uncommon' in Ceylon. External measurements of seven adults: head and body 133-158 (144), tail 80-98 (86), hindfoot 21-24 (22), and ear 14-16 (15).

[These shrews are very plentiful on Malé Island, especially in and around the bazaar and residential areas. They live in the coral-stone walls, under piles of loose building materials and refuse, and less often in holes in the ground originally dug by large land-crabs. Early in the dusk they come into the open and often invade houses and shops, their high pitched squeaking giving warning of their presence when they have been alarmed. Undoubtedly they are, on balance, beneficial creatures as they help to rid the shops of many large cockroaches and other all too plentiful noxious pests. Almost 50% of them are pure white, with dark eyes. Fleas (*Xenopsylla astia*) were found on one specimen but generally they are parasitised more by mites than by fleas.—W.W.A.P.]

Pteropus giganteus ariel Allen: Maldivian Flying Fox

1906 *Pteropus medius* Temminck, Gardiner, Fauna and Geography of Maldive and Laccadive Archipelago, **2**, Supplement, 2:1049.
1908 *Pteropus ariel* Allen, *Bull. Mus. Comp. Zool. Harvard*, **52**, 3:28, pl. figs. 1-3. Malé Atoll, Maldive Islands.
1912 *Pteropus ariel* Allen, Andersen, Catalogue of Chiroptera, **1**:335.

♂ 57.399, ♀ 57.400 Malé Atoll. ♂♂ 57.401-403, ♀ 57.404 Hululé Island, North Malé.

Maldivian name: *Va*

The only specimens hitherto recorded in collections appear to be the type and an immature female in the collection of the Museum of Comparative Zoology, Harvard, and a male collected by Gardiner now preserved in the British Museum (Natural History). (B.M. 8.12.26.1). There is also in the latter collection a dealer's skin without skull (B.M.1937.11.5.1) said to have originated from the Maldive Islands. The six skins collected by Major Phillips conform closely to Allen's description (B.M.8.12.26.1 is preserved in alcohol and therefore unavailable for colour comparison) and show no taxonomically significant differences in colour when compared with *P. g. giganteus* from the southern provinces of peninsular India. The forearm, however, is shorter than that of the mainland race. The skulls of these specimens, when compared with those of *P. g. giganteus*, are shorter, narrower, and have a shorter rostrum and comparatively heavier dentition. A summary of their external and cranial measurements and a comparison with those of twenty-seven skulls of *P. g. giganteus* from the southern provinces of India is given in Table I.

TABLE I

Comparative measurements of *P.g. giganteus* and *P.g. ariel*

Dimension	*Pteropus g. giganteus* (27 specimens)	*Pteropus g. ariel* (6 specimens)
Forearm	154—176 (169)	137—160 (152)
Condylobasal Length	65.8—75.5 (70.5)	61.2—70.7 (64.9)
Width of Brain-case (at zygomatic root)	24.0—26.4 (25.1)	23.4—25.7 (24.2)
Zygomatic Width	34.4—43.2 (39.7)	31.8—43.9 (36.4)
Postorbital Width	9.5—11.2 (10.1)	8.4—11.3 (9.5)
Interorbital Width	7.2—9.4 (8.3)	8.9—10.4 (9.5)
c—m^2	23.7—29.5 (26.8)	23.5—27.0 (25.3)
c—m^3	27.6—32.4 (30.4)	26.6—30.3 (28.4)
Mandible Length	49.9—58.5 (54.0)	47.0—56.5 (50.5)
Width m^1—m^1	18.4—22.3 (20.1)	17.8—21.0 (19.1)
Length p^4	4.3—5.1 (4.7)	4.2—5.0 (4.5)
Width p^4	2.9—3.9 (3.5)	3.3—3.9 (3.6)
Length m^1	4.8—5.7 (5.3)	4.9—5.8 (5.4)
Width m^1	2.4—3.6 (3.3)	3.1—3.6 (3.4)

As suggested by Allen (1936), this form is clearly an insular race of *Pteropus giganteus*, defined by its reduced body and cranial size. Ellerman and Morrison-Scott (1951) evidently overlooked this paper, and following Andersen (1912) listed *ariel* as a species within the *giganteus* group. *Pteropus hypomelanus maris* Allen, *Rec. Ind. Mus.* **38**: 343, 1936 from Heratara, Addu Atoll, south end of Maldive Archipelago is not listed in this work.

[Flying Foxes are plentiful throughout North Malé Atoll and are reported to be moderately so in all the atolls. They appear to be rather more diurnal than the mainland form and may be seen flying over at any time throughout the day but more commonly, of course, in the early evenings when many often come in to feed long before sunset. Passing from island to island they fly high over the seas, generally each on its own course.

There is no roost on Malé itself but two large colonies are to be found on Hululé close by, where several hundreds spend the day hanging from the branches of groups of large evergreen trees; in the early evening they fly over to Malé to raid the fruit and crops, especially the mangoes.

Although they are not eaten by the Maldivians, they are occasionally shot in order to control their numbers and protect the fruit crops.—W.W.A.P.]

Rattus rattus ceylonus (Kelaart): Common Rat

1850 *Mus ceylonus* Kelaart, *J. Ceylon Br. Asiat. Soc.* **2**:213. Ceylon.
1851 *Mus nemoralis* Blyth, *J. Asiat. Soc. Bengal* **20**:168 (Not of de Sélys Longchamps, 1841).

♂♂ 57.405-406, juveniles 57.407-409 Malé Atoll.

Maldivian name: *Meetha* or *Meeda.*

These specimens represent the common House Rat and are very similar to *R. r. rufescens* in appearance. Ellerman and Morrison-Scott (1951) use *ceylonus* for the common commensal form in Ceylon following Hinton (1919) who used *nemoralis*, but Phillips (1935) lists the Indian House Rat (*R. r. rufescens*) as introduced to the neighbourhood of ports in Ceylon and regards the native commensal form of that island as *Rattus rattus kandianus*. This material is slightly blacker and less rufous on the back than specimens of *ceylonus* from a number of Ceylonese localities, but the difference is very small.

Rattus rattus kandianus (Kelaart)

1850 *Mus kandianus* Kelaart, *J. Ceylon Br. Asiat. Soc.* **2**:212. Nuwara Eliya Ceylon.
1850 *Mus tetragonurus* Kelaart, loc. cit. 217. Hendala, near Colombo, Ceylon.
1887 *Mus kandiyanus* Kelaart, loc. cit. 326 (Emendation in reprint of 1850 publication).

♂♂ 57.410 Hululé Island, North Malé. 57.411 Malé Atoll.

Both specimens have the back yellowish brown coarsely streaked with black, the hairs with slate-grey bases. The underparts of 57.411 are predominantly buff-yellow, the hairs having light grey bases and yellow or buff tips. Those of 57.410 are cream white, with the hairs light coloured throughout their length. The feet of 57.411 are brown but those of 57.410 are much lighter and are predominantly whitish in colour. They are slightly paler and less rufous than specimens of *kandianus*, but otherwise closely resemble the Ceylonese form.

[Rats of the *Rattus rattus* group are very plentiful throughout the islands, both near habitations and amongst the undergrowth in the coconut plantations. Largely diurnal in their habits, they may commonly be met with during the heat of the day, climbing in the bushes, poking amongst the low herbage, or climbing up the bare, smooth stem of a coconut palm in order to nibble the miniature nuts in the crown. Many of them have a loathsome appearance and are, wisely, shunned by the local people for, although they do not appear to harbour many fleas, they generally swarm with mites.

In Malé, they infest the bazaar areas, graveyards, and compounds, but their numbers are kept in check to some extent by the domestic cats that have been imported for that purpose. Breeding is probably continuous throughout the year; during December, January, and February numerous nests containing young were brought in.—W.W. A.P.]

Mus musculus castaneus Waterhouse: Eastern House Mouse

1843 *Mus castaneus* Waterhouse, *Ann. Mag. Nat. Hist.* **12**:134. Philippine Islands.
1852 *Mus manei* Kelaart, Fauna Zeyl. 64. Ceylon. (Gray, 1843, List.Mamm.111. *nom. nud.*).
1865 *Mus rama* Blyth, *J. Asiat. Soc. Bengal* **34**:194. Penang.
1922 *Mus musculus sinicus* Cabrera, *Bol. Real. Soc. Esp. H.N.* **22**:166. Ningpo, Chekiang, southern China.

♂♂ 57.412-415, ♀♀ 57.417-418, Juvenile 57.416, North Malé.

Maldivian name: *Japan Meetha* or *Japan Meeda.*

Schwarz and Schwarz (1943) use *castaneus* for the House Mice from the Indian peninsula and Ceylon. These specimens agree closely in size and dorsal colour with material from Ceylon and the southern part of the Indian peninsula. Ventrally, however, four specimens are slate-grey tinged with ochreous, while the remainder are ochraceous cream with complete exclusion of grey.

[Curiously enough, House Mice were rather scarce, even in the bazaar areas, possibly due to the presence of domestic cats and too many House Rats and Musk Shrews. They live in the shops and also in houses in the residential area and have habits as in other parts of the world. Nearly 50% of them are ochraceous cream in colour, ventrally.—W.W.A.P.]

[Rabbits (*Oryctolagus cuniculus* Linnaeus).

Domesticated rabbits, of various colours, have been turned loose on several islands, notably on Willingilli, close to Malé. They have reverted to the wild state and hide amongst the undergrowth, but come out to feed in glades in the evening. It is likely that they will establish themselves as a feral species in due time.

CETACEA

Whales.

Whales visit the atolls irregularly, and are sometimes captured; there appears to be no record of the species.

Dolphins. (Maldivian names: *Comas, Firebocomas,* and *Onuthunmas*).

It was our intention to collect specimens of Dolphins. However, it was found that Dolphins and Porpoises are regarded with superstitious aversion by the local fisherfolk, so we were unable to procure any for examination. Schools of both large beaked dolphins and smaller porpoises were frequently observed close to Malé but no reliable identification could be made.

Deraniyagala (1956) states that he procured a water-worn skull, without mandible, of *Delphinus delphis* Linnaeus on Furadifuri Island.—W.W.A.P.]

SUMMARY

The mammalian fauna of the Maldive Islands, as far as it is known, consists of two indigenous species of Megachiroptera, one species of insectivore, one species of lagomorph, and two rodent species, the latter comprising three races. All but the Megachiroptera have been introduced by human agency. Of the fruit bats, *Pteropus hypomelanus maris* is the western outlier of a predominantly East Indian and Sundanesian species, linking that species to a more modified member of the *Pteropus hypomelanus* group, *Pteropus subniger,* from the Mascarene Islands, Réunion, and Mauritius. The other, *Pteropus giganteus ariel,* is an insular race of the Indian Flying Fox, as might be expected. The musk shrew, *Suncus murinus,* is commensal and has been widely distributed by man over many of the small islands of eastern Asia and the East Indies. It, together with *Rattus rattus ceylonus, Rattus rattus kandianus,* and *Mus musculus castaneus,* appears to have reached the Maldives from Ceylon. This is not unexpected, since the principal communication with the Maldives is conducted from the western ports of Ceylon while much less use is made of routes to south Indian ports. However, the rats especially show small differences in colour from the Ceylonese races and, while this may indicate a slight degree of subspeciation, it seems quite probable that the populations of shrews, rats, and mice found on the Maldive

Islands have been derived from several, including Indian, sources. The rabbit, unlike the foregoing, appears to be a deliberate introduction to the Islands.

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Some Notes on the Reproduction, Metamorphosis, and the Ecology of a Ceylonese Tree Frog *Rhacophorus cruciger cruciger* (Blyth)

BY

A. M. MORGAN-DAVIES, F.Z.S.

(*With two plates and one text photo*)

INTRODUCTION

Considerable work has been done on the taxonomy and distribution of the amphibia peculiar to Ceylon, but our knowledge of their life histories and ecology is extremely meagre. It was only very recently (Kirtisinghe, 1957) that the tadpoles of *Rana corrugata, R. limnocharis greenii, Rhacophorus c. cruciger, Rh. c. eques*, and *Microhyla zeylanica* were described for the first time, and there are still those of several Ceylonese Anura to be accounted for. The few descriptions that have appeared concerning the purely Ceylonese forms (Günther, 1876; Kirtisinghe, 1957) merely give brief accounts of tadpoles and supply little detailed information of their life histories.

In this paper I have dealt with the breeding, ovulation, 'nest' construction, larval stages, and metamorphosis of *Rhacophorus c. cruciger* (Blyth) and have added some notes on its ecology.

MATERIALS AND METHODS

This work has been based on the observations of over fifty breeding specimens in the field and under laboratory conditions and covers a period of one year. Pituitary gland injections to stimulate breeding activity have not been employed. Conditions under captivity were made, as far as possible, to simulate natural conditions. The duration of metamorphosis as recorded here is given from the observations of a single batch of eggs kept under laboratory conditions. It, however, coincides closely with the duration of metamorphosis observed for three other batches bred in captivity and for a number of batches observed in the natural state.

REPRODUCTION

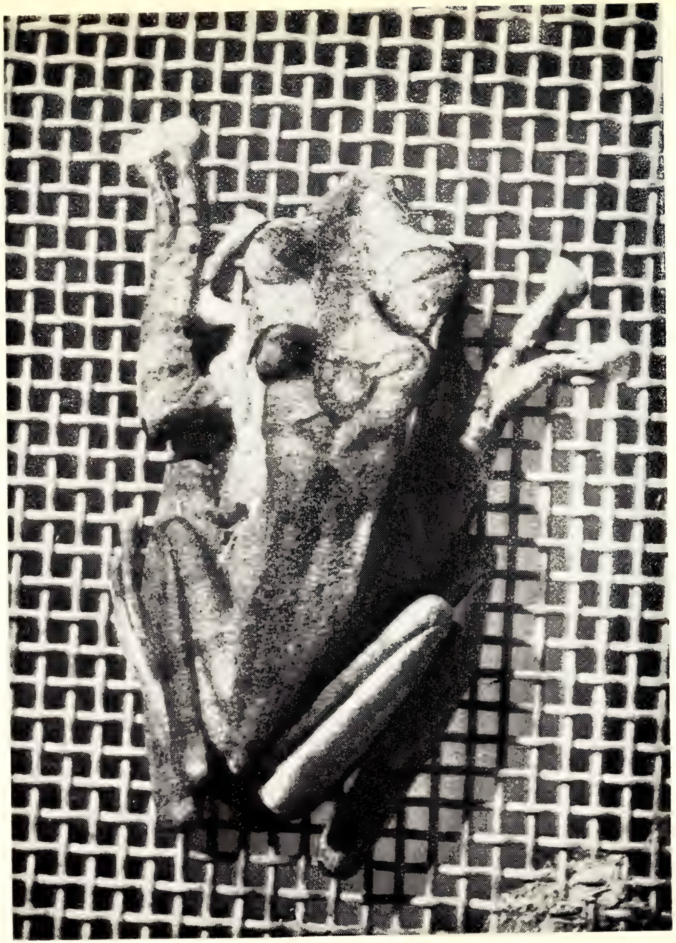
On the evening of the 25th February 1957, immediately after a shower of rain, three males and two females of *Rhacophorus c. cruciger* were collected from a small pond near Passara (2,400 ft.). One pair were already in amplexus; the remainder were squatting upon rocks. Two hours later all five animals were placed in a breeding cage and throughout the period, from capture to being placed in their cage, the mated pair did not break from the amplexus though they were handled and carried about in a collecting bag. On a number of similar occasions to separate a pair in this position was comparatively difficult owing to the firm grip taken by the male and his tendency to lash out with his hind legs.

Amplexus in this and eight other cases observed was axillary. Plate I (1) shows an earlier stage where the hands of the male were placed over the shoulders of the female. The final position is shown diagrammatically in Plate I (2) where the thumbs and fingers of the male were clenched and gripped the female firmly immediately behind the arm-pit. At the beginning of amplexus the snout of the male was just aft of a line between the female's eyes, and the vent of the male was about a quarter of an inch forward of the cloaca of the female. The legs of the male were flexed with the feet usually resting upon the thighs of the female.

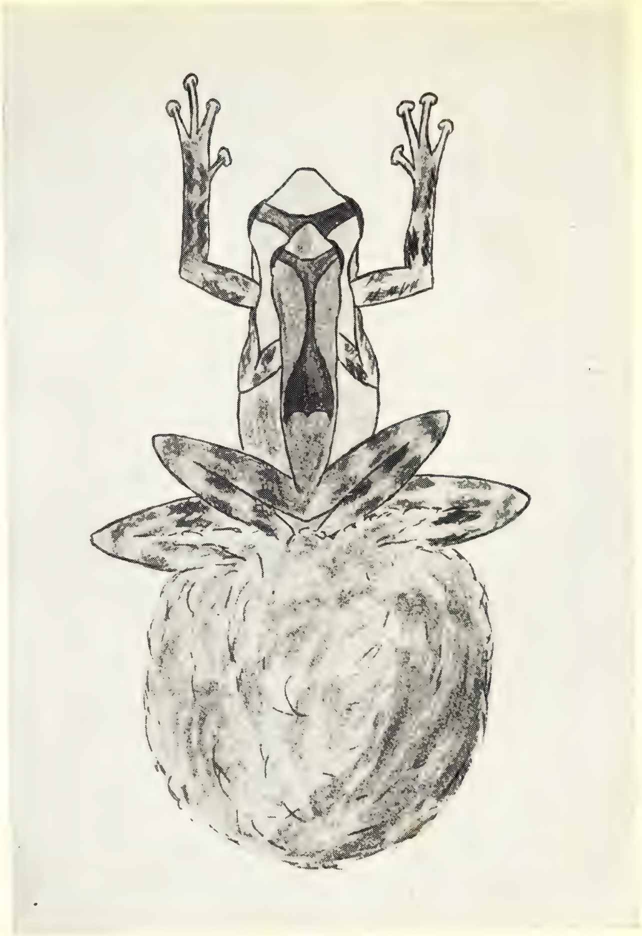
Observations in the laboratory and field revealed that oviposition, in some thirty instances, took place at night; no cases were recorded during the day. For approximately two hours after being placed in the breeding cage the mating pair continually walked around the sides of their cage (a 4-sided glass aquarium with cement base and wire mesh top, 30″×12″×9″) not settling down in one position for more than a few minutes. Occasionally they would descend to the bottom of the cage and immerse themselves up to their forelegs in water. On a few occasions they became fully immersed and swam across the cage. Throughout this period preliminary to egg laying the male made spasmodic jerks with his body and legs.

The pair showed no signs of fear at their new and unusual surroundings and finally settled down after some considerable fidgeting of the female's forelegs in order to get a firm grip of the vertical surface of the cage. At 10.10 p.m. the female cocked her thighs and shanks at an angle of approximately ninety degrees to the long axis of the body, her heels touching immediately below and about a quarter of an inch from the cloaca. At the same time the male assumed a similar position taking his feet from the thighs of the female and placing them between his and the female's cloacal opening.

A colourless and sticky liquid was then emitted from the cloaca of the female who immediately commenced to work her feet in a sideways fanning motion from the ankle, thereby working the liquid into a translucent frothy mass which became adherent to the side of the cage. At 10.15 p.m. ova emerged from the cloaca of the female

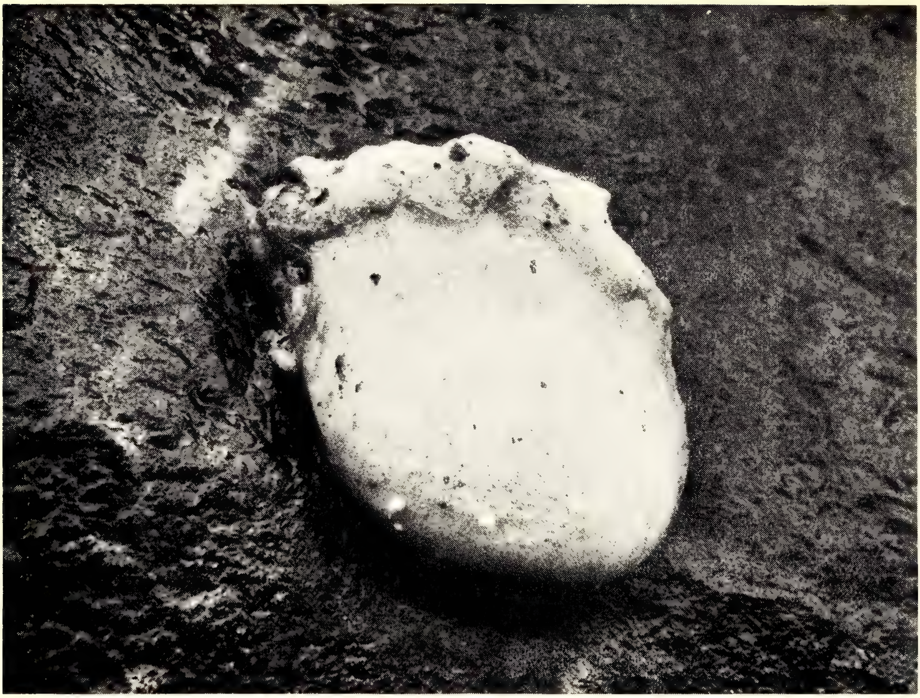


1. Male and female *Rhacophorus c. cruciger* in early amplexus.

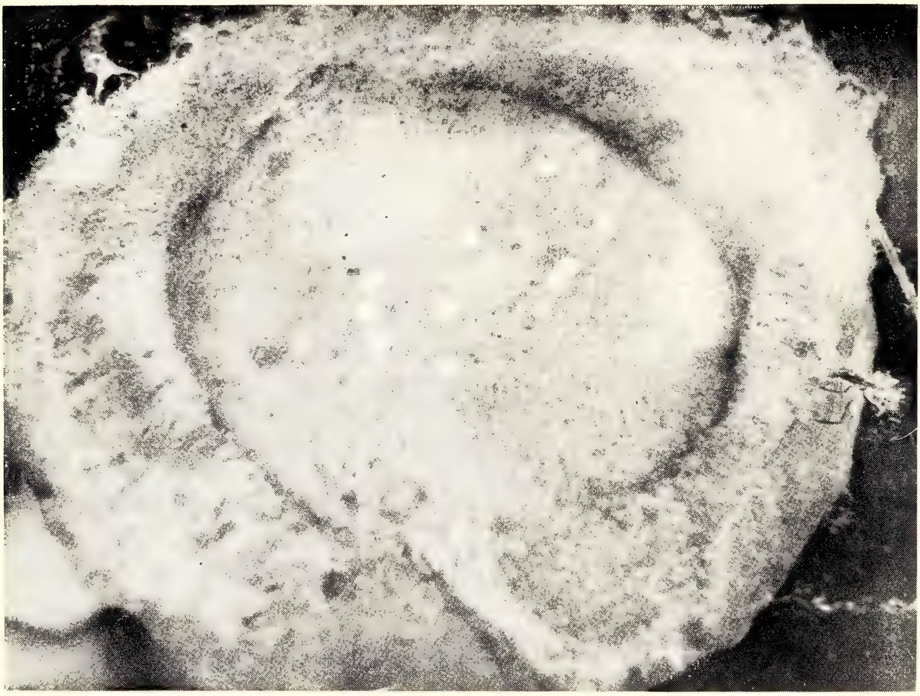


2. Position during egg laying (diagrammatic).

Photos : A. M. Morgan-Davies



3. Nest on vertical side of rock.

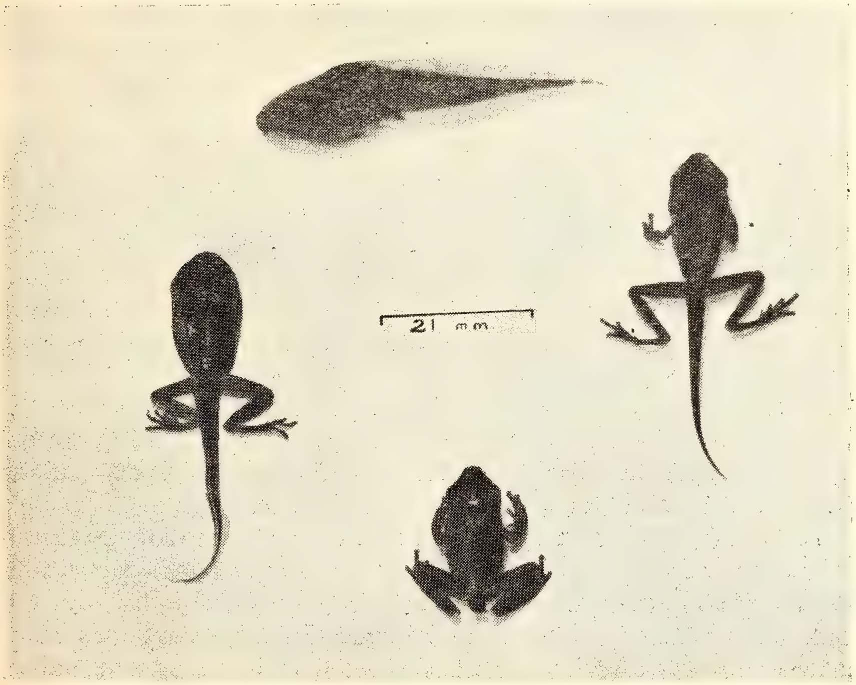


4. Nest opened out to show distribution of eggs.

Photos : A. M. Morgan-Davies

and the male assumed a strained attitude of the abdominal muscles. The ova did not emerge in one sudden gush but slowly, a few at a time, and at short intervals of ten to fifteen seconds. During these intervals the female kept up a steady fanning motion with her feet which distributed the eggs amongst the foam that was slowly increasing in volume. At the same time the male worked his feet slowly up-and-down from his cloaca, past that of the female, and into the centre of the frothy mass. By 10.30 p.m. the frothy mass was a pale pink-fawn colour and about two and a half inches in diameter and the ova were expelled at slower intervals, the frothy mass becoming considerably more tacky. The female grew more exhausted and her breathing more laboured; her body had reverted almost to its normal size.

At 10.45 p.m. the male slowly dismounted from the female who had ceased depositing her ova. The colour of the frothy mass was still a pink-fawn but of a very slightly darker hue on the outside; the centre, however, was still white. Three minutes after the male dismounted the female slowly moved away from the nest which was then three to four inches in diameter and covering her feet and part of her shanks. Ten minutes later she had parted from the nest and was



Four stages in the development of *Rhacophorus c. cruciger* (Blyth) obviously extremely exhausted with the effort of making her nest and extracting herself from the mass of foam which had become extremely tacky and disinclined to come away from between her legs. Twelve hours later the coloration of the nest had changed to a pale blue-green.

DISCUSSION ON BREEDING AND NEST-CONSTRUCTION

Rhacophorus cruciger is gregarious in its breeding areas. As many as nine nests were found within an area of fifty square feet, whilst outside of this area, although suitable for breeding and nest making, none was found. The majority of nests were constructed on the vertical sides of rocks, two to three feet above water level. A few were found up to thirty feet high amongst the terminal foliage of trees overhanging water, a few others attached to small sedge just above or at water level. In all instances the nests were made overhanging still water.

There is no doubt that it is the female alone who is responsible for the production of the foam nest. To prove this a single gravid female was placed by herself in a cage and that night a fully constructed foam nest with eggs was made.

The foam is formed from the sticky colourless liquid emitted by the female during ova deposition and which is slowly agitated into a frothy mass by a sideways pendulum motion of the feet of the female from the heels. The reason for the movement of the feet of the male is uncertain; its likely object is to prevent the foam from spreading in an upwards direction engulfing the feet of both sexes and thereby making it increasingly difficult for them finally to extract themselves from their viscous egg mass.

Immediately after construction the nests are from two and a half to three and a half inches in diameter and either a pale blue-green or light fawn in colour. Their weight is approximately 350 to 500 grains, but fluctuates according to weather conditions and age.

Plate II (4) depicts an opened-out nest twelve hours old. A centre and an outer layer can clearly be seen; the former is still tacky and contains the majority of ova, the latter is comparatively dry with an outer crust which is brittle and parchment-like, although this may not be quite the case if the nest is exposed to incessant rain and a damp atmosphere.

From a count of ova in six nests it would appear that the number of ova in each nest may vary from 240 to 300 which represents the whole complement of each female. The average diameter of the ova is 2 mm. with a maximum and minimum diameter of 2.4 and 1.8 mm. ± 0.10 mm. Their colour is a pale cream throughout.

A great number of nests found in the Passara area were infested by the dipteran fly *Caiusa indica* which deposits its eggs upon the frothy mass within a few hours of its formation and before it gets its crisp and brittle outer casing. The damage caused by this fly is very considerable and the number of frog's ova that finally hatch in an infected nest is negligible or even nil. From this one would assume that, apart from the brittle outer casing possibly serving as an insulator from excessive temperatures, it must also serve as a barrier to intruders as no nests became infected once this outer casing became set and hardened.

METAMORPHOSIS

Pre-feeding stage.

The early embryonic stages are passed within the nest, and not till about the fifth or sixth day when the nest collapses due to the weight of the developing ova, do the tadpoles fall to the water. During the first three to five days of aquatic life the yolk sac and external gills are clearly visible. The upper side of the head and body and the tail muscle is a pale buff; the abdomen is a creamy white with the anterior abdominal vein clearly visible. About the tenth day after emerging the external gills are absorbed, pigmentation becomes more intense, and the tadpole more active. At this stage the measurements of the tadpoles are approximately: total length 10 mm.; length of head and body 4 mm.; width of body 1.75 mm.; depth of tail 1.9 mm.

Feeding stage.

During the next eighty days the tadpoles increase in length to about 50 mm., by which time they have acquired a characteristic pattern of body and tail pigmentation and the hind limbs are fully developed. The coloration at this stage is a dark olive. The tail musculature and dorsal fin membrane are heavily covered with melanophores, whereas in the ventral fin membrane the melanophores are sparsely scattered. At this stage the measurements of the tadpole are as follows: total length 50 mm.; length of head and body 19 mm.; width of body 10 mm.; depth of tail 7.5 mm.; length of tibia 9.5 mm.

Within the next twenty days the forelimbs emerge, the melanophores in the ventral fin membrane are more intense, and the markings approximate very closely to the adult frog. The tail is then totally absorbed and the measurements of the young frog at total metamorphosis are approximately: length of head and body 20 mm.; length of tibia 11 mm.

REPRODUCTIVE ACTIVITY

In the south-east of Ceylon breeding coincides with the north-east monsoon rains for the seven months extending roughly from October to April, the early months being those of greatest intensity. During these first months of breeding when the rainfall is more or less regular ova deposition is at a far greater intensity but thereafter it declines and normally precedes a fairly heavy shower or a few days of continual mist.

COLORATION

The most usual coloration of the adult frog would appear to range from a pale yellow to yellow-ochre, pale pink to a burnt sienna, various shades of grey, greenish brown, sepia, and olive. In the paler range of colour variations the hour-glass marking on the dorsum is either very faint or entirely lacking; in the darker colour range this characteristic marking is most pronounced. At night the usual colour is from a pale straw yellow to yellow-ochre; during the day it may vary very considerably between individual specimens under the same conditions of light and temperature. The colour of the young frog at metamorphosis is normally a silver grey.

ACKNOWLEDGEMENT

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Evolution: the Taxonomer's Approach

BY

R. B. SEYMOUR SEWELL

PART I

The Science of Taxonomy and Systematics must be the oldest science in the world for it began, so we are told, with Adam : ' and out of the ground the Lord God formed every beast of the field and every fowl of the air and brought them to Adam to see what he would call them : and whatsoever Adam called every living creature, that was the name thereof. And Adam gave names to all cattle and to the fowl of the air, and to every beast of the field ' (Genesis II, 19-20). But since that early date the science has undergone a number of modifications and changes.

One of the earliest schemes of classification of which we have definite knowledge was that put forward by Aristotle about 2000 years ago ; in this he divided the then known animals into groups, of which the components all possessed certain characters. As our knowledge increased of the existence of the numerous forms of animals these were grouped together in accordance with their structure or morphology : one of the earliest scientists who specified that Taxonomy must be based solely on structure was de Candolle, a botanist, and he laid down the principle that physiological characters, which we now know are of such great importance in the life of organisms, were useless in classification, which must be based on comparative morphology.

The present day study of Systematics may be said to have commenced with the publication of the 10th Edition of Linnaeus's SYSTEMA NATURAE in 1758, in which animals and plants were given a double name, the first being generic and indicating the group to which an animal or plant belonged, and the second being specific indicating that this form differed from all other forms in the genus. This and all other individuals that agreed with it exactly formed a species, and if there were present only slight differences then these were regarded as variations. With the invention of the microscope more and more details of structure could be detected and it gradually became necessary to divide the larger groups, the genera into smaller subgroups and the species into subspecies, and within these much smaller groups it became recognised that even the offspring of a single pair of progenitors were different from each other and from their parents. Linnaeus[1] (1775, Part I, Section lxxvii, p. 51), after reviewing previous attempts at classification, remarks : ' Besides all the above-mentioned systems . . . which may be called artificial there is a natural method, or nature's system, which we ought to endeavour diligently to find out . . . and this system of nature is no *chimera* will appear . . . from hence, that all plants, of what order soever, shew an affinity to some others to which they are nearly allied '. Not long after Linnaeus had formulated his classification, Lamarck[1] clearly foresaw the difficulties that would arise if too much attention was paid to details of structure for he wrote (1809, ch. II, p. 50) : ' It is useless for naturalists to take up all their time in describing new species, fastening on all the shades of difference and the minute particularities of their variations, so adding to the immense list of known species . . . if the philosophy of the science is neglected ; in that case their progress will be illusory and the whole work will remain incomplete.'

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[1] Linnaeus, 1775. THE ELEMENTS OF BOTANY (PHILOSOPHIA BOTANICA). Trans. by Hugh Rose, T. Cadell, London.

About a hundred years after Linnaeus, the acceptance of the theory of Evolution introduced another complexity into our scheme of classification, for we now had to envisage a method by which animals that were known to have existed in past geological periods could be related to those that are alive at the present day ; to recognise, as Lamarck (loc. cit. ch. I, p. 33) had done, that 'there is no dividing line in nature itself between one species and another' ; we had to try and formulate a scheme that would express a phylogenetic scheme of classification, a real 'natural history', and it became generally accepted that the process could be envisaged as a tree, which includes the main trunk with its numerous branches, each branch giving off twigs, and these finally bearing the leaves, which were supposed to represent the various species living at the present day. But evolution does not stop short at this point, it is still going on, and the animals that we know to-day are not only different from their predecessors but will be different from their successors in some future era.

So to-day the Taxonomist is brought face to face with one of the problems that nature has set us, namely the way in which and by which characters are transmitted from parents to offspring, and the nature of the agencies that bring this about or that cause them to vary. Perhaps a better simile than a tree would be that of a railway system in which one starts from a large central station and thereafter as we progress the names of 'stations' through which we pass change, as for instance we pass from Liverpool Street and arrive at Broxbourne, then a little later at Bishop's Stortford, then at Audley End, and finally Cambridge, but all the time travelling along a given line ; at intervals a branch line may split off leading to Saffron Walden and this might even curve round again and come near to, if it did not actually rejoin, the original main line, thus indicating the process known to zoologists as 'convergence', or another line might start from a different part of London and after travelling through Hitchin eventually reach Cambridge by a different route, thus indicating the polyphylitic origin of Cambridge itself. The late Dr. Calman[1] (1930) in his Presidential Address to the Zoology Section of the British Association for the Advancement of Science at Bristol remarked : 'It may be a counsel of perfection to suggest that no one should introduce a specific name without undertaking at least a partial revision of the genus including it : but there are very many instances where the multiplication of species might be postponed until we learn something about those that are supposed to be known' ; and a year later Gurney[2] (1931) pointed out that in the group that he was then studying, the genus *Cyclops* of the Copepoda, we had reached a stage where extensive and detailed study had resulted in the creation of a number of subspecies and varieties, often based on minute differences, in any given species and that it was impossible to judge of the value of such small differences until we know the range of variation that may be found in such a species, first in a stable environment and secondly in environments of rather different character. Lowndes[3] (1934), working on the same group, remarks : 'That taxonomy is getting to an impossible state must be recognised by everyone' ; he points out that, as was foreseen by Lamarck, 'as taxonomy progresses more and more detail is incorporated with the result that specific distinctions, unless they are carefully tested by breeding experiments, become more and more unreliable'. Chappuis, who is an authority on this group, regarding Lowndes's view remarks, as recorded by Lindberg[4] (1942), that this author appears to have reached the paradoxical conclusion that the more detailed the description of an animal the more the animal becomes unrecognisable, or in other words the better defined species is that which is known only from a single specimen. But isn't this an actual fact ? Taxonomy was originally based on the species concept and in the Linnaean tradition the description of a species applies solely to a single individual, the 'Type', and the inclusion of small differences in the description makes it more and more difficult to determine whether these differences are actually specific, unless we also know that they are inherited, and we may be dealing with slight differences that are merely individualistic as, for instance, the finger prints of human beings, no two of which have so far been found to be identical though they may be very nearly so in 'true twins'. Even such minute differences can be classified, but such a classification, though still morphological, is purely artificial and not 'natural' in the systematic sense of the term.

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[1] Lamarck, 1809. PHILOSOPHIE ZOOLOGIQUE, Dentu, Paris.

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[1] Calman, W. T., 1930. The Taxonomic Outlook in Zoology. Presidential Address, Section D, Zoology : British Association for the Advancement of Science, Bristol.

[2] Gurney, R., 1931. BRITISH FRESH-WATER COPEPODA. Vol. I. The Ray Society, London.

[3] Lowndes, A. G., 1934. Copepoda. Report of an Expedition to Brazil and Paraguay in 1926-27. *Jour. Linn. Soc. London*, Zoology, Vol. 39.

[4] Lindberg, K., 1942. Cyclopides (Crustaces Copepodes) de l'Inde, XVI. Notes sur *Mesocyclops rylovi* Smirnov et *Mesocyclops vermifer* Lindberg. *Rec. Ind. Mus.* **44** : 149.

More recently taxonomists have had to take into consideration the conditions under which animals and plants live and the extent to which differences in the environment may cause differences in the animal itself, and they have to bear in mind the results obtained by the study of the science of Ecology.

HOW THEN CAN ONE DEFINE A 'SPECIES'?

The original conception was that a 'species' was a group of organisms that closely resembled each other, any differences being merely trivial; but Darwin[1] (1892, p. 294) warns one that 'it should also be constantly borne in mind that any linking variety between two forms, which might be found, would be regarded, unless the whole chain could be perfectly restored, as a new and distinct species; for it is not pretended that we have any sure criterion by which species and varieties can be discriminated'. Poulton[2] (1904) in his Presidential address to the Entomological Society, under the title of 'What is a Species', lays down that the gaps between species must be absolute, otherwise they would not be different species, and he postulates that 'inhibition of gene flow results in the establishment of a new species population', thus assuming that all specific differences are due solely to genic action. He divides species into two categories, Sympatric and Asympatric, the former being those where two or more species inhabit the same area and are due to ecological divergencies in this area leading to the separation of individuals by reproductive isolation because they occupy different niches: Asympatric species occupy different areas. But this so-called explanation merely explains why a new and absolutely different set of organisms becomes established as a population; it makes no attempt to explain how the difference came into being.

Bateson[3] (1909), after discussing the sterility or partial sterility of hybrids obtained by crossing different varieties, remarks: 'We are confronted with two distinct alternatives: (1) We may apply the term species promiscuously to all distinct forms . . . There is no distinction, logical or physiological, to be drawn between them. Some contain more factors and others fewer, and (2) We may follow the conventions of systematists and distinguish the outstanding and conspicuous forms . . . as species and leave the rest unheeded.' Fisher[1] (1930) defines species as follows: 'The groups most nearly corresponding to species would be those adapted to fill so similar a place in nature that any one individual could replace another, or more explicitly that one evolutionary improvement in any one individual threatens the existence of the descendants of all the others'. The difficulty of accepting Fisher's definition lies in the fact that in many—one might say in most—cases we are profoundly ignorant of the exact nature of the environment in which so many species live at the present day, and know practically nothing about the environment in which those animals, which are known to us as fossils, lived in past ages ; we may be able to conclude with some degree of certainty whether they were terrestrial, aerial, or aquatic, and the geological character of the deposits in which their remains have been found will give a clue to whether the aquatic environment was fresh-water or salt ; but any assumption regarding the detailed and exact conditions of the physico-chemical nature of the environment is pure guess-work. Furthermore, if we are to adopt Fisher's definition we must include all the various characters of an organism, no matter how small the differences may be, and also make the assumption that every character, such as the presence or absence of a seta or spine in a particular position must be an 'improvement' and must have a survival value for that individual. Among the Muscidae the classification is largely based on relatively small differences in the chaetotaxy, and Fisher's definition ignores the possibility, even the probability, that many such small differences may be neutral, being neither beneficial nor harmful so that their presence or absence would in no way be a bar to one form occupying the same biological space as another ; and yet if such a small difference were inherited it would constitute a valid basis for regarding the two forms as two species. Hale Carpenter[2] (1951), quoting from Mayr (1942) has pointed out that the modern definition of a species is a group of an actually and potentially interbreeding natural population, which is reproductively isolated from other such groups, and a subspecies is defined as 'a geographically localised subdivision of the species which differs genetically and taxonomically from other subdivisions of the species'. He goes on to point out that 'Nowadays it is recognised that no two individuals can be exactly alike on genetic and biometric grounds and therefore no one specimen should be considered typical : what is typical is the mean of the population, and thus a population becomes the unit . . . Thus a *biological* definition replaces a morphological one, stressing the completeness or incompleteness of the gap which separates species according to the presence or absence of interbreeding'.

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[1] Darwin, C., 1892. THE ORIGIN OF SPECIES, 6th edition.

[2] Poulton, E. B., 1904. What is a Species? Presidential Address to the Entomological Society, London. 1922.

[3] Bateson, W. B., 1909. MENDEL'S PRINCIPLES OF HEREDITY. Cambridge University Press.

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[1] Fisher, R. A., 1930. THE GENETICAL THEORY OF NATURAL SELECTION. Clarendon Press, Oxford.

[2] Hale Carpenter, G. D., 1951. Taxonomy and Geographical Distribution. Lectures on the Practice of Botanical and Zoological Classification. The Linnean Society of London.

But 'nearly every morphological character used to separate species may vary geographically within the species' [Hale Carpenter (loc. cit., p. 51)] and in the case of a continuously and widely distributed species the two ends of the chain may be so different that they certainly would not interbreed.

The present-day position has been summed up by Smart (1950)[1] as follows : 'Until comparatively recently, the morpho-systematist was expected to supply the definition of what constituted a species. As systematic knowledge increased this task became more and more difficult, and ultimately the systematist could do little more than say that a species was such a segregate of organisms as he decided to designate as a species ! '[2]

THE INFLUENCE OF THE MENDELIAN THEORY OF INHERITANCE

The discovery of the work of Mendel and the gradual development of the theory of Evolution by means of the ' genes ' in the chromosomes of the nucleus created an immense amount of interest and enthusiasm among biologists and they claimed that here was the true and only explanation of how animals and plants have evolved in the past. But it seems to me that they have overcalled their hand and have claimed too much for this theory. Hogben[3] (1930) points out that 'to-day biologists are beginning to realise that evolution must furnish an explanation of specific differences which are not adaptive as much as of specific differences which are adaptive' ; but are any of the so-called 'Mutations' discovered in the Mendelists' experiments either adaptive or specific ? They are for the most part, if not universally, non-adaptive, if not actually lethal. The Mendelians have merely shown that the inheritance of non-adaptive characters may be transmitted to offspring according to certain mechanisms, e.g. the genes. They have in no instance that I know of shown that the genes actually cause the change or that, in the majority of instances, the mutational changes are in any sense specific, much less that they are generic. Dr Robert C. Miller, of the University of Washington[1] (1946) writes : ' Sequence of events, however often repeated, affords no proof of causal connection . . . If it be objected that this strikes at the root of all scientific method, it may reasonably be replied that the scientist should himself be the most eager to examine critically the bases of his own procedure. Such an examination is inevitable when the boundary between physical science and metaphysics becomes so indefinite as it is at the present time' ; and surely the same may be said with regard to the boundaries between physics, chemistry, and biology. He goes on to say that there are excellent pragmatic reasons for assuming a causal connection between events or series of events characterised by a high degree of statistical correlation . . . but it should be pointed out that this assumption does not justify the ordinary idea that the event which precedes in time is the cause, while that which follows is the effect.

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[1] Smart, J., 1950, Post-Darwinian Development of Taxonomy (Zoology). Lectures on the Development of Taxonomy. The Linnean Society of London.

[2] Prof. Graham Canon in a letter has kindly reminded me that the difficulty of giving a clear definition of what constitutes a species was clearly seen by Darwin (THE ORIGIN OF SPECIES, 6th Edition, 1897, p. 34) who wrote : ' In determining whether a form should be ranked as a species or a variety the opinion of naturalists having sound judgement and with experience seems the only guide to follow. We must, however, in many cases, decide by a majority of naturalists, for few well-marked and well-known varieties can be named which have not been ranked as species by at least some competent judges'. It thus appears that we are no nearer reaching a final definition of what constitutes a species at the present time than we were about 100 years ago, when Darwin and Wallace first propounded their theory of evolution.

[3] Hogben, L., 1930. THE NATURE OF LIVING MATTER. Kegan Paul, Trench, Trubner and Co. Ltd., London.

The Mendelian discoveries introduced a complexity into the work of the Taxonomist who is trying to identify the species to which a collection of very similar specimens may belong. In December 1913 I collected a number of small crabs that were living under stones between tide marks in an area of about 25 square yards of a beach in Nankauri Harbour, Nicobar Islands, and in November of the following year I obtained several more specimens from the same area that agreed with those captured earlier ; at first sight all these examples, of which there were 43, appeared to correspond in the main with the description of the species *Xantho* (*Leptodius*) *sanguineus* A.M.-Edw. ; but a more careful examination showed that these examples fell into four distinct groups, as follows :

GROUP I

Males with a typical male type of claw of chocolate-brown colour :

No.	Greatest breadth of carapace mm.	Length of great chela mm.
1	16.0	18.0
2	16.5	18.25
3	18.0	21.25
4	18.5	19.75
5	16.5	20.0
6	20.0	23.25
7	21.0	24.25
8	22.0	25.0
9	25.5	30.25
10	27.0	34.5
11	28.75	36.0
12	33.25	39.25

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[1] Miller, R. C., 1946. *Science*, Vol. 75.

GROUP II

Males with a modified female type of claw of black colour :

No.	Greatest breadth of carapace mm.	Length of great chela mm.
1	10.5	10.5
2	14.0	15.0
3	17.25	17.85
4	18.75	20.75
5	20.5	23.0
6	21.0	25.0
7	21.75	24.25
8	22.25	25.0
9	23.0	27.25
10	23.25	28.75
11	25.75	31.0

GROUP III

Females with a claw of the male type but smaller than in the true male, of chocolate brown colour :

1	14.75	15.0
2	16.0	17.25
3	17.0	17.25
4	17.0	18.5
5	17.75	16.5
6	18.0	19.0
7	18.75	19.75
8	20.0	20.0
9	20.5	20.0

GROUP IV

Females with typical female type of claw, coloured black:

1	12.0	13.0
2	12.5	13.25
3	12.75	14.0
4	13.0	13.5
5	15.0	16.5
6	16.0	16.75
7	16.5	17.75
8	16.75	16.50
9	17.25	16.75
10	18.75	16.50
11	22.0	22.50

In addition to the difference in colour of the male type of claw from the female, chocolate-brown instead of black, the dactylus in the examples of Group I is stouter and much more sharply curved, the teeth on the biting margin are different and the terminal spoon is much larger and has a larger horse-shoe shaped border ; in the females with the typical female type of claw (Group IV) of which 9 out of the 11 were ovigerous, the dactylus is not so strong as in the typical male ; it is less strongly curved and the terminal horse-shoe is smaller. It must also be pointed out that in none of the examples in Groups II and III was there any sign that the individuals were or had been parasitised by *Sacculina* and none of the specimens in Group III was ovigerous. The above differences between the two groups in both sexes at once raised the question, had I here two species? I submitted this question to the late Dr Calman and he at once said ' Two species'. But had I? According to the Mendelian theory by crossing males, of which half the number possessed a dominant male gene and the other half a recessive, with females of the same species we should expect to get the following result :

A .. dominant male,
a .. recessive male,
b .. female.

F_1 would give equal numbers of

A plus b and a plus b ;

and at F_2 we should expect to get

1 Aa 1 Ab 1 ab and 1 bb,

or Aa typical males with the male type of claw
Ab females with the male type of claw and probably infertile
ab males with the female type of claw and
bb typical females with the female type of claw and normally ovigerous.

The proportional measurements of the carapace and chela give no help in reaching a decision for the measurements of the two sexes fall in continuous lines of growth, the male rate being on a curved line and the female rate on a straight one, and the abdomen of the two sexes being perfectly normal and characteristic of the two sexes. In many of the Crustacea it has been shown that the heterogonic growth of such an appendage as the great chela is due to two factors that are at work during the course of development, the ordinary hormone that controls development in both sexes and a sexual secretion that may modify the degree of development in either sex.

At its inception the theory of the genetic inheritance of bodily characters by means of the genes in the chromosomes of the nucleus was most attractive, one gene controlling one character ; but the enthusiasts soon went far beyond this early conception.

It was postulated that all bodily changes are due to changes in the genes and that these changes occur spontaneously and at random ; it was supposed that sooner or later a mutation might arise that would produce a change that gave the individual an advantage over all the others and that from that moment Natural Selection set in and the progeny of this fortunate individual caused the gradual elimination of all the individuals of the original type. Bather[1] (1928) in his Presidential address to the Geological Society asked: 'Why do mutants so often assume the same characters as the adaptive modifications? Does the influence that produces the modification also induce a change in the germ, and, if so, why is that change in the same direction as the modification?'. He suggests that there is a physico-chemical change in the germ cells themselves as well as in the body. Simpson[1] (1951, p. 133) very rightly observed that 'The mutationist discoveries were bewildering to many field naturalists and palaeontologists, because they in particular were well aware that evolution *cannot* (the italics are Simpson's) be a purely random process and that progressive adaptation certainly does occur'.

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[1] Bather, F. A., 1928. The Fossil and its Environment. Annual Address to the Geological Society.

Fisher (1930, p. 13) admits that 'however profound our ignorance of the causes of mutation may be, we cannot but ascribe them, within the order of nature as we know it, either to the nature of the organism or to that of its surrounding environment, or more generally to the interaction of the two', and Lowndes (1932, p. 294)[2] endorses this view and remarks that 'it is generally considered that the cause of morphological variation is to be sought for either in those processes that one may describe as genetic or else environmental, but of course it will be conceded by anyone that these two cannot be separated'. Simpson (loc. cit., p. 39) points out that 'surviving organisms must meet the minimum requirements of life in an available environment and changes can only occur on the basis of what already exists. The environments available are not limitless and each permits survival on its own terms only', and he goes on to say that even these broad rather obvious limitations suggest strongly that orientation in evolution is not determined by some characteristic within the evolving organism or solely by external factors in their environment but by both and by some interplay between the two. Of recent years the view appears to have grown up that the environment can have nothing to do with mutation and that adaptation is not in any way due to environment though it is well recognised that environment may have a profound effect on the development and growth of an organism, and its continued existence by means of Natural Selection. Simpson (loc. cit., 1951, p. 88) considers that 'the development of the individual is effected not only by the inherited growth determinants but also by the conditions under which growth occurs. Greater or less differences in the environment (for instance in soil or weather) affect them (the individuals) as they grow, no matter how near each other they may be'. Carter[3] (1951) has emphasised that 'throughout the evolution there was repeated change of habitat and habit as well as of structure' and that 'we may regard structural evolution as being in large part adaptation to the new conditions to which the animal became exposed during or after change in habitat and habit of life'. When discussing the character of a cline, where a species exhibits continuous variation from one end of its habitat to the other Carter (loc. cit., p. 159) claims that 'many of the changes that occur along the course of a cline are adaptive to changing environmental conditions in the different parts of the range'. This type of variation is claimed to be 'non-genetic' but associated with these adaptive changes are genetic changes and these may be either adaptive or non-adaptive. A little later (loc. cit., p. 164) he claims that 'there is also no doubt that animals vary and that some part of the variation, that part that has a genetic basis, is inherited. It is irrelevant to the argument that another part, phenotypic variation, is not inherited ; this must be simply set aside and disregarded in any discussion of Darwin's Theory'. Yet later still he claims that 'Phenotypic variations are not inherited, and are therefore not themselves of evolutionary value : but they may prepare the way for genetic differentiation . . . The characters so acquired may be given a genetic basis by recombination or mutation (of the genes) when these occur'.

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[1] Simpson, G. G., 1951. THE MEANING OF EVOLUTION. A Mentor Book. The New American Library.

[2] Lowndes, A.G., 1932. The Result of further Breeding Experiments on four species of *Cyclops*. *Ann. Mag. Nat. Hist.* (10), IX, 265-297.

[3] Carter, G. S., 1951. ANIMAL EVOLUTION. Sidgwick and Jackson Ltd., London.

WHAT EXACTLY DO WE MEAN BY ADAPTATION ?

One definition of adaptation, given by Allen (1929) in his Hooker Lecture to the Linnean Society of London, states 'by an adaptation we mean nothing more than a character of an organism which has enabled a species to survive itself as such or to survive until it is transformed into another species. It is survival that gives the measure of adaptation'. Fisher (1930) defines it in the following terms : 'An organism is regarded as adapted to a particular situation or to a totality of situations which constitute its environment, only in so far as we can imagine an assemblage of slightly different situations or environments in which the animal would on the whole be less well adapted : and equally in so far as we can imagine an assemblage of slightly different organic forms which would be less well adapted to that environment'. What exactly he meant to be inferred from this definition I do not know but, on the one hand, any number of small differences may be found in the structure of an organism that would appear to have no possible effect on its survival in any environment ; and, on the other hand, recent investigations, especially by agriculturalists, have shown that the presence or absence of trace elements in the soil can have a quite marked effect on the well-being of the herds that feed on the grass that grows on it ; and the possibility that any watery habitat having slight microchemical differences from other, otherwise similar, habitats may have a profound influence on aquatic organisms does not seem to me to be unlikely.

A. R. Wallace (1889) long ago pointed out that most writers on the subject considered that isolation was a very important or even an essential factor in the formation of new species ; and both he and Darwin were of the opinion that if the environments were absolutely similar for two isolated portions of a species, then no divergence between the isolated portions would take place. But, as Wallace pointed out, it is practically impossible that the environment of the isolated portion can be exactly like that of the bulk of the species ; differences will be physical, such as climate and soil or water. Size of area, relation to winds, seas or rivers would certainly differ, and biologically the differences are sure to be considerable. He remarks that 'While isolation is an important factor in effecting some modification of species, it is so not on account of any effect produced or influence exerted by isolation *per se* but because it is always and necessarily accompanied by a change of environment, both physical and biological. Natural selection will then begin to act in adapting the isolated portion to its new environment'. He sums up his view (Wallace, loc. cit., p. 171-2) in these words: 'I have shown that the importance of geographical isolation for the formation of new species by natural selection has been greatly exaggerated because *the very change of conditions, which is the initial power in starting such new forms*, leads also to a local stational segregation of the forms acted upon' (the italics are mine. R.B.S.S.)

Every zoologist, I imagine, who has studied the geographical distribution of an aquatic species, provided that the area of distribution was sufficiently wide and embraced regions with different physicochemical characters, must have realised that in different areas the individuals of such a species often exhibit small structural differences. In many such cases the differences may be correlated, in all probability, with slight differences in the environment. During the course of growth and development of each individual differences arise in the proportions of its several parts, and it is just such differences as these, when found in examples of what appear to be a form very closely resembling but yet differing slightly from a known species, in a different locality isolated from the original source of the type of the species, that have induced the observer to conclude that he was dealing with a genetically different form and gave it a new name with the status of a new subspecies or even a species.

Gurney[1] (1933, p. 286) called attention to the fact that in a genus of Cyclops, *Mesocyclops* Sars, Kiefer in his Key of 1929 included 16 species

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[1] Gurney, R., 1933, BRITISH FRESH-WATER COPEPODA, Vol. III. The Ray Society, London.

but added 4 more in an appendix ; a year later this number had increased to 23, and by October 1932 had further increased to 35 species. In 1929 Kiefer divided the genus into two subgenera, *Mesocyclops* s. str. and *Thermocyclops* Kiefer, and at the present time there are as many as 39 species and subspecies in this last subgenus alone. One of the characters, that has been used to discriminate between the species and subspecies in this subgenus is the proportional lengths of the two spines that are borne on the distal margin of the terminal segment of the endopod of the 4th swimming leg, and in the Table below I give these proportions in a number of these subspecies or species :

Group I

Species of *Thermocyclops*	Average proportional lengths of terminal spines of endopod 3 of P4.		Range	
	Inner	outer		
oithonoides	4.100	1.0		
retroversus	3.86	1.0	3.32 — 4.01	1.0
hyalinus persicus	2.85	1.0	2.8 — 2.9	1.0
,, *hyalinus*	2.21	1.0	1.6 — 2.7	1.0
,, *ndalaganus*	2.145	1.0	2.12 — 2.17	1.0
,, *kivuensis*	2.08	1.0		
,, *byzantinus*	2.058	1.0	2.03 — 2.11	1.0
,, *macrolasius*	2.055	1.0	1.93 — 2.14	1.0
iwoyiensis	2.60	1.0	2.4 — 3.1	1.0
neglectus decipiens	2.67	1.0		
,, *neglectus*	2.39	1.0	2.0 — 2.78	1.0
,, *prolatus*	1.79	1.0		
infrequens nigerianus	2.37	1.0		
,, *eduardensis*	2.20	1.0		
,, *infrequens*	1.864	1.0	1.76 — 2.07	1.0
mongolicus	2.353	1.0		
mahéensis	2.324	1.0	2.14 — 2.48	1.0
vermifer	2.28	1.0	1.89 — 2.83	1.0
pachysetosus	2.12	1.0		
rylovi	1.89	1.0	1.45 — 2.18	1.0
tenuis	1.889	1.0		
inopinus	1.882	1.0		
tinctus	1.765	1.0	1.57 — 1.96	1.0
operculatus aberrans	1.50	1.0		
schmeili f. *marmagoensis*	1.426	1.0	1.158 — 1.545	1.0
,, *schmeili*	1.06	1.0	1.01 — 1.125	1.0
,, *hastatus*	0.895	1.0	0.83 — 0.96	1.0
dybowskii	0.842	1.0	0.80 — 0.895	1.0

In the above table the figures all refer to the proportions in the adult female, as in most of these species the male is unknown. Gurney[1]

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[1] Gurney, R., 1931. BRITISH FRESH-WATER COPEPODA. Vol. I. The Ray Society, London.

(1931, p. 20) pointed out that 'it is not impossible that some forms which we know as subspecies or even species may be "adaptations" to particular conditions, without genetical relation between separate colonies', and it seems obvious that no reliance can be placed on such small differences in proportions of minute parts of an organism as specific characters till we know far more about the development of such forms under natural conditions in habitats of different characters.

As I have already pointed out, the modern trend of thought appears to be that the environment *per se* has nothing whatever to do with the adaptational evolution of an organism. Lowndes[1] (1934, p. 83) remarks 'I am convinced that the term *Adaptation to Environment* in its generally accepted meaning is at the present time hardly a scientific conception', and he goes on to explain (loc. cit., p. 86) that 'if the alteration in environment has any marked effect at all it cannot be a beneficial one, except in the rather rare case in which some particular gene mutation, conferring some advantage, is submitted to natural selection'. Fisher (1930) states that in the physical environment, geological and climatological changes must always be slowly in progress and these as they continue become harmful to the greater number, for the same reason as mutation in the organism itself will generally be harmful ; but if mutation in a gene or series of genes is 'random', why should it nearly always be to the disadvantage of the organism ? I do not profess to be a mathematician, but it seems to me that if mutations are truly random while the environment is slowly changing then just as many mutations might be beneficial as might be harmful and that the great majority might be completely neutral. Certainly no environment is static ; it is continually changing within certain limits. In aquatic environments the change is not only seasonal but is also diurnal, and every organism is capable of adjustment to a certain range of change. It is only when this range is exceeded or the change takes place too rapidly that it becomes harmful or lethal. The geological environment to which Fisher refers is characterised by changes that are for the most part extremely slow and very gradual so that many generations of organisms will succeed one another before any marked effect would be experienced, and the organism would have ample opportunity to become adapted to the new environment.

Huxley[2] (1956, p. 321) has called attention to the information that may be gained by a study of populations and their genetics. He remarks that 'The study of population genetics grades into that of taxonomy' and he claims that 'Morphism (genetic polymorphism) provides natural markers in the shape of readily distinguishable morphic forms (morphs)'. 'Morphism', Huxley claims (loc. cit.), 'is a special type of adaptive intraspecific differentiation', yet it is claimed that phenotypic morphisms may be dependent on the co-operation of two separate genes. Valentine[1] (1956, p. 315) in a study of Variation and Polymorphism in *Viola* claims that 'Phenotypic plasticity is common in flowering plants and it is clearly important in habitat adaptation' but he goes on to remark that 'populations from different habitats which differ in phenotype can sometimes be shown to differ little, if at all, in genotype. More commonly, however, such phenotypic differences are found to be partly under genetic control'.

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[1] Lowndes, A. G., 1934. Reports on an Expedition to Brazil and Paraguay in 1926-27. Copepoda. *Jour. Linn. Soc. London.* Vol. 39.

[2] Huxley, J. S., 1956. Morphism as a clue in the study of population dynamics. *Proc. Roy. Soc.* Series B, Vol. 145.

Kiefer (1952)[2], who has been responsible for a large percentage of the above list of so-called species and subspecies in the subgenus *Thermocyclops*, appears to be convinced that environment *per se* can have no influence on the actual production of new species and that these are always the result of random changes in one or more genes in the nucleus of the developing ovum : if we accept this view, then we surely must postulate that, in every case in which we find a new variety or subspecies of a well authenticated species in a habitat different from that in which the parent species exists, the random appearance of a modified gene that has been so beneficial as to have enabled the progeny to survive must have occurred with extraordinary rapidity, or else assume that the change in the habitat has so affected the gene complex that it has caused the necessary change, in which case we have reason to believe that a new species is in process of being evolved. The only other explanation of this change is that such minor morphological differences have arisen, not as a gene mutation but from the direct effect of the environment on the organism and its developing ova, causing changes in the phenotype resulting from changes in the rate of growth and associated alteration in the proportional size of parts of the adult, and that this change will occur in successive generations as long as the 'species' inhabits the same area.

Simpson (1951, p. 39) affirms that 'in particular instances of environmental change, evolving organisms do not respond in a uniform way, as if the evironment were causing the change in structure' : this sweeping statement seems to me to ignore some of the most obvious changes that have taken place in the evolution of large groups of animals during past ages when they were evolving into new forms in a new environment. Many animals of different orders and phyla exhibit very similar adaptations, as for instance the evolution of suckers on the lower lip and throat of hill-stream fishes and amphibia to counteract the effect of the rapidly-flowing water (*vide* Hora,[1] 1930), or the evolution of a stream-lined form of body in fishes, aquatic reptiles, and in mammals, that have either always lived in or have reverted to an aquatic environment ; and such changes must surely have occurred simultaneously with the change of habitat. The adoption of an aerial existence has been accompanied by the evolution of wings, as in insects, birds, in one reptile, the Pterodactyl, and in bats ; and, though the mechanical structure in these various forms has been different, there can be no doubt that the presence of a wing is intimately connected with the aerial habitat. Conversely the change of habit and the abandonment of this faculty of flight has led to the suppression and disappearance of wings in insects and birds. In other animals the development of a cylindrical worm-like form of body, as in the earth-worms and in various genera of the sand-dwelling Copepoda, must either have arisen first and have been the precursor of the change of habitat or at least have been coincident with it. Conversely, in animals that have never left their ancestral habitat, such as the Brachiopod *Lingula* and certain molluscs of the Oyster family, we can see that the animal has remained practically unchanged at any rate externally. It would thus appear that in the absence of any alteration of the habitat lies the possibility of a continuation of the same bodily structure.

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[1] Valentine, D. H., 1956. Variation and Polymorphism in *Viola. Proc. Roy. Soc.* Series B, Vol. 145.

[2] Kiefer, F., 1952. Copepoda Calanoida und Cyclopoida. Explorat. van het National Albert Park, zending H. Damas 1935-36. Inatit. des Parks National. du Congo Belge, Fasc. 21.

Even at the present day we find certain instances in which a geographical change of environment accompanied by relatively slight changes in the physico-chemical character of the habitat seems to be accompanied by and to be producing a structural change in the course of a few generations. The study of the geographical distribution of a small marine Copepod, *Acartia clausi* Giesbrecht, has indicated that the species is world-wide in its distribution and has developed small structural differences in different regions that have resulted in these variations being given specific or subspecific names, such as *Acartia simplex* Sars and *Acartia ensifera* Brady, both from the south-west Pacific region, *Acartia clausi gaboonensis* T. Scott from the Gulf of Guinea, and *A. clausi hudsonica* Pinney from Hudson Bay. Steuer[2] (1923, 1929) has called attention to certain differences, especially that of size, in examples of this species that have been taken in different areas of the north Atlantic and its offshoots ; there is a 'giant' race in the North Atlantic Drift and a 'dwarf' race in the Canary Current and in his later paper he suggests that these differences may be due to the varying salinities in the different regions, the larger examples being found in water of higher salinity, as is so commonly the case in organisms inhabiting the sea :

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[1] Hora, S. L., 1930. Ecology, Bionomics and Evolution of the Torrential fauna, with special reference to the organs of attachment. *Phil. Trans. Roy. Soc. London* Series B, Vol. 218.

[2] Steuer, A., 1923. Baustein zu einer Monographie der Copepoden-gattung *Acartia*. *Arb. Zool. Inst. Wien,* I, pt. 5.

Steuer. A., 1929. Die Arten der Copepodengattung *Acartia* in der Mediterranean Provinz. *Sitz. Ber. Akad. wiss. Wien* 138.

Area	Total body-length in mm.	
	♀	♂
East coast of North America	1.12–1.25	1.0–1.1
North Atlantic Drift	1.131–1.265	1.04–1.124
North Sea, Norwegian coast	1.15–1.47	1.0–1.31
Bay of Biscay	1.2	1.08–1.18
Adriatic	1.222–1.307	1.131–1.209
Canary Current	0.977–1.07	0.99

Associated with this change in size there is a corresponding change in the number of small spinules that are present on the postero-lateral margin of the 5th thoracic segment (*vide* Sewell, R.B.S., 1946)[1] :

Area	Number of spinules on post. margin of thoracic segment 5.			
	♀		♂	
	left	right	left	right
East coast of North America	0		..	
North Atlantic Drift	1-6	1-5	2-5	2-5
Norwegian Coast	4-6		..	
Adriatic	2-4	3-5	4-6	3-5
Canary Current	0-3	0-4	0	0

Thus as we trace the distribution of this small planktonic organism in its drift round the clock-wise circulation in the north Atlantic we get a gradual increase in size and in the number of spinules in succeeding generations as we pass from west to east in the North Atlantic Drift and its offshoots and this is followed in later generations by a decrease in size and in the number of spinules as we pass back again from east to west in the Canary Current and the North Equatorial Current to the east coast of North America ; but where the species has passed out of this circular movement, as in the North Sea and the Adriatic, the number of spinules continues to be high and it would seem probable that here a phenotypic variation has been changed to a genetic character, as was suggested by Carter (*vide supra*, p. 27).

Gurney (1931 p. 29)[2], as I have already mentioned (*vide supra.* p. 30), has remarked that 'it is not impossible that some forms that we know as subspecies may be "adaptations" to particular conditions without genetical relation to separate colonies, and he goes on to give as an example of this the case of the multiple origin of the Copepod *Limnocalanus macrurus* Sars from *L. grimaldii* (De Guerne), a species that appears to be universally distributed throughout the Arctic region, in both the Baltic region and the Great Lakes of North America, probably as a result of the change from a salt to a freshwater environment at the close of the last Glacial Epoch, a change that must primarily have induced a physiological adaptation, which has been followed by a morphological change. Annandale[1] (1924) studied the mollusc fauna of lakes across the width of Asia, and called attention to the frequency with which 'the earlier' shell form commences with a smooth shell and gradually passes through a stage exhibiting spiral ridges to, finally, forms with a tuberculate shell, the tubercles being situated along the lines of the former ridges. In the Cretaceous the parent marine form managed to invade fresh-water throughout the Tropical belt and gave rise to a number of different genera : in America there arose the genus *Tulotoma*, in the Pleistocene beds of Europe we get the subgenus *Protulotoma*; in Asia we have the genera *Taia* and *Margarya*, and in Africa in Lake Tanganyika we have the genus *Neothauma*, and in the Philippine Islands the genus *Dactylochlamys*. Conditions of life in all these areas do not seem to have been identical but Annandale has remarked that 'We have evidence in *Taia* as in *Margarya* that the most highly sculptured forms are of multiple origin and have been evolved independently in different lakes' ; and Baini Prashad[2] (1928), when commenting on the same phenomenon, notes that the more highly sculptured forms are all found in lakes or other big areas of water in which the conditions of life are uniform and where almost always species of different families and genera become specialised ; and during the time that has elapsed between the Pliocene and the present day many of the lakes have become smaller in size or have dried up altogether. Annandale sums up his conclusions in the following words : 'These somewhat isolated living and fossil species . . . provide additional evidence, in itself of little importance but cumulative in value, that in certain regions of the earth's surface there is or has been some influence at work which has produced a similar collective peculiarity in the shells of the Viviparidae on diverse occasions and in different parts of the world . . . What the influence is or was we do not know. I would hazard the suggestion that it had something to do with a peculiar stimulus in the water which exerted its influence for long periods and from generation to generation, ultimately affecting the germplasm as well as the soma of the molluscs'. Annandale goes on to argue that the presence of this sculpturing even in the embryonic shells of the more specialised forms of both *Taia* and *Margarya* seems to prove that the effect is not due merely to the effect of the environment on the individual. 'Once the tendency has been implanted in the race, it can have full play only in favourable environment '; and he sums up his position in the words: 'My explanation of the phenomena discussed in this paper implies an acceptance of the doctrine of the survival of the fittest and at the same time a firm belief in the inheritance of one kind of acquired character. The traumatic injury of an individual can probably not affect the race, but unless we assume that the long continued and gradual influence of environment can do so it is difficult to see how adaptive characters can ever have arisen'. In the case of these Viviparidae, studied by Annandale, it is difficult to see why the possession of a tuberculate shell should be an advantage, though there is no reason to doubt that it was not actually harmful and if due to a gene then this gene must somehow have been altered to produce a tuberculate shell or else had been supplanted by a new gene that produced this change, and that this change occurred in a number of widely-dispersed areas and in different geological periods. It seems probable that similar evolutionary changes are taking place at the present day in cases in which examples of different genera belonging to different suborders of the Marsupialia have undergone identical changes when transferred from Australia to New Zealand. Le Souef[1] (1930) recorded such changes in three species of Wallaby which had been introduced 60 years previously and in each case the fur had become longer and more silky, the coloration darker, and the markings more pronounced: a fourth species introduced at the same time had not at the time of Le Souef's writing shown any change but exactly similar changes had taken place in Opossums that had also been transferred. As I pointed out (Sewell[2], 1931) we have here a clear case of identical changes taking place in examples of species belonging to different sub-orders of the Marsupialia that had been transferred from one habitat to another, namely from Australia to New Zealand.

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[1] Sewell, R. B. S., 1948. The Free-Swimming Copepoda : Geographical Distribution. *Sci. Reports, John Murray Expedition* 1933-34 Vol. VIII, No. 3.

[2] Gurney, R., 1931. BRITISH FRESH-WATER COPEPODA. Vol. I. The Ray Society, London.

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[1] Annandale, N., 1924. The Evolution of the Shell-Sculpture in Fresh-Water Snails of the Family Viviparidae. *Proc. Roy. Soc. London*, Ser. B, Vol. 96.

[2] Prashad, Baini, 1928. Recent and Fossil Viviparidae. A Study in Distribution, Evolution and Palaeography. *Mem. Ind. Mus.* Vol. 8, No. 4.

When Nelson Annandale was showing his results of the study of the production of tuberculate shells in the Viviparidae to another zoologist, his visitor remarked 'Well, I think that ought to convince the sceptics that environment can produce adaptations'. To which Annandale replied 'I fear, my dear Sir, that you underrate the ingenuity of the Mendelists'. Such changes as I have noted above suggest the possibility, which Simpson denies, that a change from one habitat to others with identical characters but different from the original environment may produce in any given species identical changes in structural characters. Such changes as have been found in species that occupy different environments have in many cases induced Taxonomists to regard the slightly different organisms as constituting a new subspecies or even species, and to assume, since they believe that all mutations are caused by corresponding changes in the gene-complex, that there has been a most convenient, though random, change in the genes. Fisher (1930) remarks that 'the investigator who faces the fact as an unavoidable inference from what is now known of the nature of inheritance will direct his enquiries confidently towards a study of the selective agencies at work throughout the life history of a group in their native habitats rather than to speculation on the possible causes which may influence these mutations . . . The experimental study of agencies capable of influencing mutation rates is of the highest interest for the light it may throw on the nature of these changes . . . We should altogether misinterpret the value of such researches were we to regard them as revealing the causes of evolutionary modification'. And yet if we are to reach a knowledge of the real and fundamental causes that can influence a gene or a group of genes to change their function it is essential to take into consideration the possibility that the external environment may have something to do with this change. It would seem that for some time in the foreseeable future the Taxonomer will have to go on as he has done in the past, relying mainly on morphological characters as the criteria for diagnosing species but at the same time he should try to obtain as full an account of the physico-chemical character of the environment as possible, especially in the case of those animals that inhabit an aqueous habitat ; he should not be content to investigate merely the temperature, gaseous content, and pH, but should arrange for a competent chemist to carry out a complete analysis of the salts in solution. As Hogben (1930, p. 283) has remarked : 'A biologist should not be prevented from studying physical chemistry to an advanced stage because he has neither time nor inclination to devote to a tedious routine of analysis', and, if he has neither the time nor the necessary knowledge to carry out such analyses himself, he should, if possible, get an expert to do the analysis for him.

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[1] Le Souef, 1930. *Australian Zoologist*, Vol. 6, p. 111.
[2] Sewell, R. B. S., 1931. Presidential Address to the Asiatic Society of Bengal.

(*To be continued*)

Notes on the Liverwort Flora of East Nepal

BY

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(*With two plates*)

The hepatic flora of the kingdom of Nepal was first made known by the collections of Wallich from the central part and of Hooker from the far eastern part of Nepal. These collections were worked up by Mitten (4). According to Stephani (6), who greatly enhanced our knowledge of the Hepatics, there are 62 species over 32 genera that occur in Nepal. Kashyap (3) mentions many species that he has not seen but which were described by Stephani. Chopra (1) lists the same species as given by Stephani. Horikawa (2) records the mosses and hepatics collected by the Japanese expeditionists from west Nepal during 1952 and 1953. It is interesting to note that there are no members of the Anthocerotales and Marchantiales in the lists. More recently Pande received a collection of Hepatics from the British Museum, London. This collection was made during 1949-54 by Sykes, Stainton, Williams, and Polunin from west Nepal, and a tentative list of the Liverworts has been published (5).

I have been interested in the study of the vegetation of east Nepal since 1948, and been collecting liverworts as well. In my collection are some species that are additions to the bryology of Nepal. Certain species that Kashyap described on the authority of Stephani have also been collected. There are some species that have morphological features of interest.

The following is the list of specimens collected:

Anthoceros gollanii St.

On moist rocks at 5,000 ft. near Chainpur. (May '52). An addition to the bryology of Nepal.

Anthoceros erectus Kash.

On soil at 4,500 ft. at Sundrijal near Kathmandu (May '52).

Marchantia nepalensis L. et L.

On rocks at 4,500 ft. near Charikot (April '52); also along sides of streams at 3,500 ft. near Chainpur (May '54), and at 6,000 ft. near Those (Sept. '56).

Abnormalities in female receptacles are very common.

Marchantia palmata Nees

Along sides of streams at 3,500 ft. near Chainpur (May '54) and at 6,000 ft. near Those (Sept. '56). Growing mixed with *M. nepalensis* at both the localities.

Lunularia cruciata Dum.

Growing on the sides of walls and embankments at 4,200 ft. at Kathmandu (May '52). An addition to the bryology of Nepal.

Dumortiera hirsuta Reinw.

Growing in a cave along with *Conocephalum* at 5,500 ft. in Tinjura forest between Dhankuta and Chainpur (May '54); in flowing water at 6,000 ft. near Those (Sept. '56), and 7,500 ft. at Phaplu (Sept. '56).

Conocephalum conicum (L.) Necker.

On the sides of a spring at 5,000 ft. at Tenkhu (May '53); in a cave along with *Dumortiera* at 5,500 ft. in Tinjura forest (May '54); in flowing water at 6,000 ft. near Those (Sept. '56), and at 7,500 ft. at Phaplu (Sept. '56).

Asterella blumeana Nees

On rocks at 5,000 ft. near Charikot (April '52). An addition to the bryology of Nepal.

Asterella angusta St.

On rocks at 4,500 ft. at Those (Sept. '56).

Plagiochasma appendiculatum L. et L.

On rocks at 5,000 ft. near Charikot (April '52); at 4,500 ft. near Chainpur (May '54); and 4,500 ft. beyond Bhandara (Sept. '56).

Plagiochasma articulatum Kash.

On rocks, drying up; at 3,000 ft. near Dolakha (Sept. '56). Addition to the bryology of Nepal.

Plagiochasma cordatum L. et L.

On rocks at 12,000 ft. near Kalinchok (April '52).

Plagiochasma nepalensis St.

On rocks at 4,500 ft. near Chainpur (May '54). Kashyap has described *P. simlensis* and also agrees that Stephani's *nepalensis* appears to be the same as *P. simlensis*.

Plagiochasma sp.

A material collected from Chainpur area at 4,500 ft. agrees partly with the description given for *P. intermedium* by Kashyap.

Riccia natans Linn.

Floating in slow moving stream at Godavari at 3,000 ft. (May '52).

Pellia fabbroniana Raddi [syn. *P. calycina* (Tayl.) Nees]

On moist rocks at 4,500 ft. at Sundrijal near Kathmandu (June '52).

Pellia epiphylla (L.) Lindb.

In flowing stream at 7,500 ft. near Phaplu. Found growing in association with *Dumortiera* (Sept. '56). An addition to the bryology of Nepal.

Metzgeria hamata Lindb.

On tree trunk at 8,000 ft. near Dongen (May '53). An addition to the bryology of Nepal.

Frullania pyriflora St.

Epiphytic at 8,000 ft. beyond Papung (May '53). An addition to the bryology of Nepal.

Plagiochilla mittenii St.

On wet rocks at 8,000 ft. beyond Papung (May '53). An addition to the bryology of Nepal.

Plagiochilla sp.

On moist rocks at 8,000 ft. in Tinjura forest (May '54). The material agrees with the description of an unidentified specimen given by Kashyap and referred to as Sp. 'B.' from western Himalayas.

Plagiochilla sp.

Also collected from the same locality as the previous specimen. Does not agree with any described specimen in Kashyap's Liverworts of the western Himalayas. Unidentified.

Chiloscyphus sp.

Collected on moist soil and rocks at 8,000 ft. in Tinjura forest (May '54). Unidentified.

The species that possess features of interest are:

Plagiochasma cordatum L. et L.

The pores are large and bound by 4 series of 8 cells. Rarely there are 5 series, and also there are 9 cells in a ring. The pores are very much raised from the surface of the thallus. On comparison with the other available material it was noticed that no other species had such projecting pores. The radial walls are very thick, and we do not have any material which has such thick-walled pore-cells. The epidermal cells also attract attention in having the angles very much thickened. *Plagiochasma appendiculatum* is reported to have variations in the number of cells bounding the pores and the trigones are insignificant. Thus the elevated pores along with the much thickened radial walls and the prominent trigones mark out the species from *Plagiochasma appendiculatum*.

Plagiochasma nepalensis St.

The pores are minute, bound by 4 or 5 cells; and there are two rings of cells. The radial walls are slightly thickened. The pores are slightly raised from the surface of the thallus. The epidermal cells are not angled and the walls are uniformly thickened, although the thickening is not very heavy. Kashyap (3) has taken his *P. simlensis* to be the same as *P. nepalensis*. On comparison with material which totally agrees with the description of *P. simlensis* it is found that the specimens collected from East Nepal are very different. It is felt that *P. simlensis* and *P. nepalensis* are two different species.

Conocephalum conicum (L.) Necker.

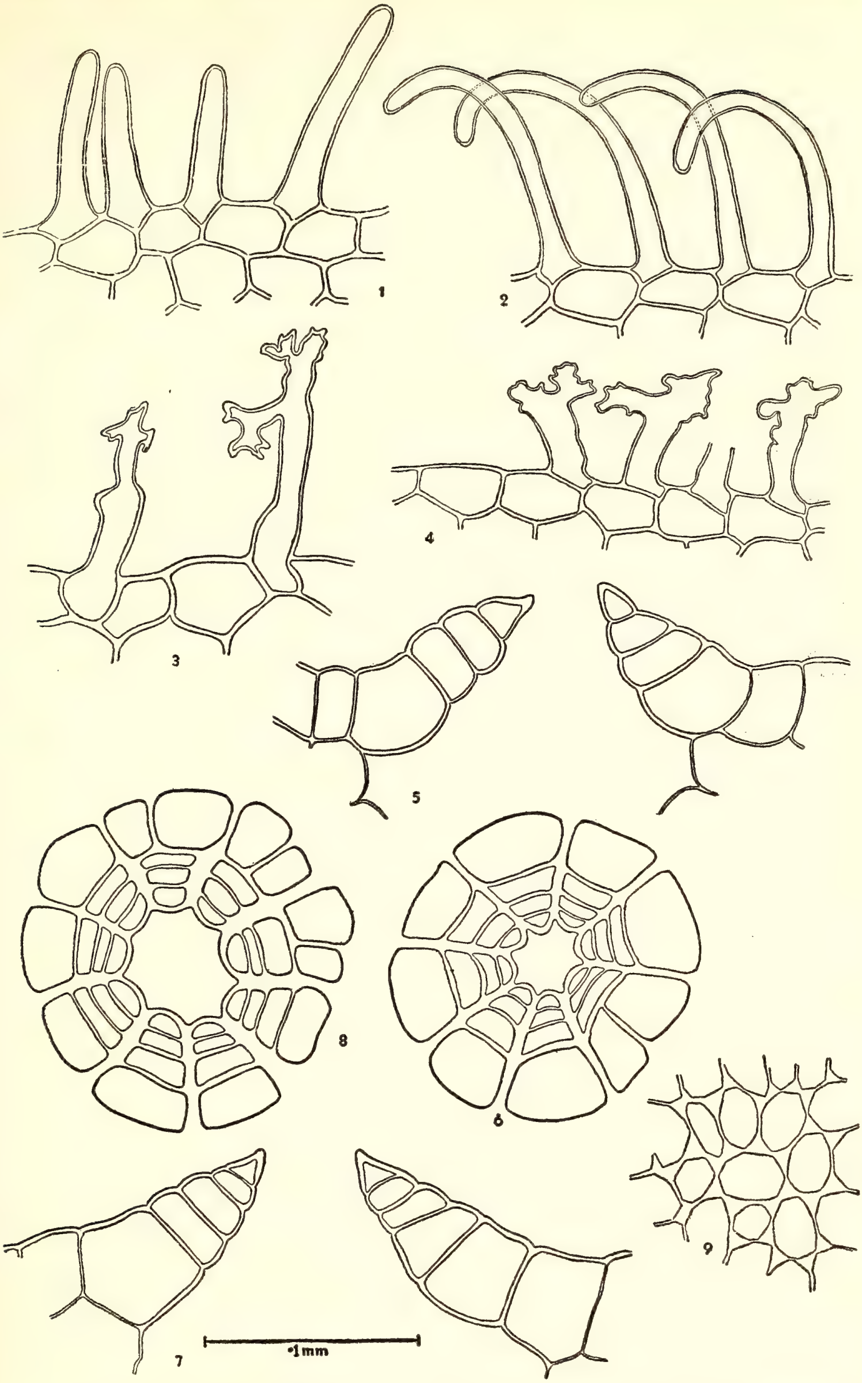
The majority of the smooth and tuberculated rhizoids are twisted in the material collected from Those and Phaplu. There are some rhizoids that have few tubercles.

Pellia epiphylla (L.) Lindb.

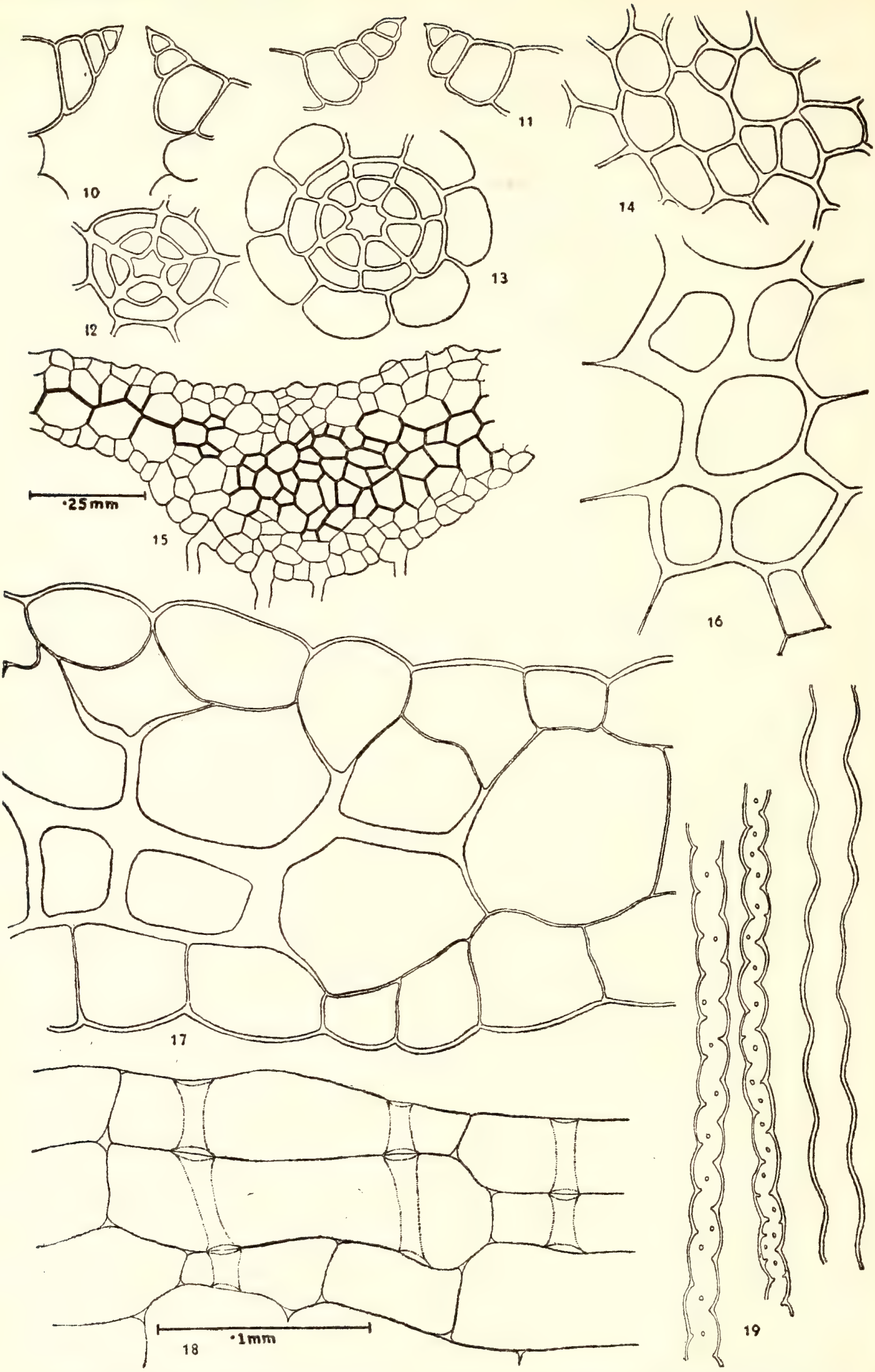
Macvicar described interlacing thick bands on the walls of the cells of the midrib for this species as well as for *P. nessiana*. Specimens of *P. epiphylla* collected from east Nepal possess interlacing thick bands in practically the whole of the midrib, even the cells of the wings possess these bands. In the middle of the smaller cells there is a single band, while the larger cells may even have two bands. In a transverse section of the thallus the bands are seen to taper gradually, and this observation is substantiated in the longitudinal vertical section as well.

Metzgeria hamata Lindb.

The thallus is strongly convex. The hairs on the midrib are mostly straight; some curved hairs also occur. The hairs on margins are



Figs. 1-4 *Metzgeria hamata* ; 1-2 Straight and curved hairs, 3-4 rhizoids. Figs. 5-9 *Plagiochasma cordatum* : 5-6 usual pores, 7-8 pores with more than the usual number of cells, 9 epidermal cells with prominent trigones.



Figs. 10-14 *Plagiochasma nepalensis*, 10-13 pores in side views and surface views, 14 epidermal cells. Figs. 15-18 *Pellia epiphylla*; 15 t. v. s. thallus (20 μ), 16-17 thickening bands of the midrib and wing respectively, 18 l. v. s. of the thallus. Fig. 19 rhizoids of *Conocephalum conicum*.

in two rows: one row developed from the dorsal surface and directed upwards, and the other row developed from the ventral surface and directed downwards. The hairs are mostly curved; some straight hairs also occur and they are smaller than the curved hairs. Along the margin also occur hair-like rhizoids with their tips expanded. These rhizoids have been described by Kashyap (3) as 'hamate hairs'. I feel that Kashyap's *Metzgeria himalayensis* is not different from Lindberg's *hamata.* Kashyap has figured curved hairs in his species and under the synonymy has given Stephani's *Metzgeria curviseta.* Lindberg's name being the oldest is valid, and Kashyap's *himalayensis* goes down as a synonym.

Dumortiera hirsuta Reinw.

An examination of the material collected from three different localities growing under different conditions leads to the conclusion that all the specimens are referrable to only the one species *hirsuta.* The upper epidermal layer is smooth or with a few papillate cells, or the entire surface is covered with papillate cells, thus the surface is velutine. These differences in the upper epidermal layer along with the differences in the length of the carpocephalum are the effect of the conditions under which the plants grow. Specimens growing under water have the upper epidermis entire or with a few papillate cells far apart, and the average length of the carpocephalum is 3.5 cm.; while specimens growing in exposed situations have the epidermis velutine and the average length of the carpocephalum is 2.5 cm.

It may also be mentioned here that I collected *Sphagnum* from east Nepal; in FAUNA AND FLORA OF NEPAL HIMALAYA (p. 279) Horikawa mentioned that *Sphagnum* was non-existent on moist ground in Nepal Himalayas.

ACKNOWLEDGEMENTS

I am indebted to Dr. S. K. Pande for going through the manuscript and making valuable suggestions. I would also like to express my gratitude to the Bombay Natural History Society and Sir Dorabjee Tata Trust for financing the 1956 tour to East Nepal.

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On the Collection, Acclimatisation, and Transport of Mullet Seed in West Bengal (India)[1]

BY

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(*With one plate and one text figure*)

INTRODUCTION

The culture of grey mullets in embanked brackish-water areas is an established indigenous industry in the estuarine areas of West Bengal (Hora and Nair, 1944; Pillay, 1954) and experimental mullet farms have been established in the State of Kerala (John, 1948; Pillay, 1948). Mullets are also cultivated in freshwater ponds in the coastal areas of West Bengal and in the Madras State (Pillay, 1949; Job and Chacko, 1947).

Culture of mullets in Bengal is carried out in *bheris*, which are embanked brackish-water areas in the process of reclamation for paddy cultivation. The stocking is effected by merely letting in tidal water which brings in the fry. This is done only during the winter months when fry of certain quick-growing species of mullets are available. But along with them come other slow-growing species which usually form the bulk of the mullets in the *bheris*. By selective stocking, fish culture in these *bheris* could considerably be improved and a greater production of economically important fishes could be obtained. At present there is no organised mullet seed industry to cater to the requirements of the fish farmers. For the organisation of such an industry, a knowledge of the different species of mullets available in the area, the method of distinguishing the fry of the different species, the seasons of occurrence of the fry, the types of areas from where they could be collected, and the methods of collecting, conditioning, and transporting them is very essential. With the object of obtaining such information certain observations were carried out on the mullet fry resources of West Bengal and the findings are briefly described in this paper.

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[1] Paper presented at the 7th meeting of the Indo-Pacific Fisheries Council held at Bandung, Indonesia in May 1957. Abstract of the paper is being published in the Proceedings of the Council.

In the field surveys connected with the earlier part of the work, I received the assistance of Sri J. C. Malhotra of this Station, to whom my thanks are due.

COLLECTION OF MULLET FRY

The fry of saltwater mullets can be collected from almost all the estuarine waters in West Bengal up to the tidal zones. But shallow marginal areas of rivers, tidal streams, creeks, swamps, and inundated fields are more suitable for their collection. Where a freshwater stream joins the river or a brackish-water area, there may usually be seen schools of mullet fry which swim against a slow current of water and may then be easily collected in large numbers. In estuarine and coastal swamps and creeks subject to tides, the fry are, however, stranded in shallow pools and puddles when the tide recedes (Plate, fig. 1).

Experimental fishing in the river Hooghly at Bhagbazar during different periods of the year has shown that the largest catches of fry can be obtained during the spring ebb tides, just before the high tide sets in. Collection is often difficult at very high tides when the current is strong.

In order to examine whether there is any marked lunar periodicity in the availability of mullet fry as generally believed, quantitative collections of *Mugil parsia* fry were made from the Hooghly at Calcutta on every alternate day during four consecutive lunar cycles commencing from December 1954 to March 1955. The quantitative estimates of fry collected indicate that there is a somewhat marked periodicity in the availability of fry of *M. parsia* in the river at this point. Collections were richest about 4 to 6 days after the full or new moon. The causative factor, however, appears to be physical, the strong tides operative at the time of the full and new moons bringing more fry farther up the river than at other times. These observations, however, do not throw any light on the existence or otherwise of a lunar periodicity in the actual spawning of the species. The quantitative study has also shown that the peak of abundance of *M. parsia* fry in the Hooghly is reached during the latter half of February, their number declining thereafter. By the end of March the fry were no longer present in the collections at Calcutta.

Small-meshed drag-nets or dip-nets are generally used by the local fisherfolk for the collection of mullet fry in this State. Where the river banks are not steep, collections can be made with either of these two types of nets. The drag-net, locally known as *jnhaji jal,* is rectangular in shape (about $4\frac{1}{2}$ ft.×2 ft.) and has two bamboo sticks attached along its width at the two ends (Plate, fig. 2). Two persons are required to operate this net, of whom one carries a floating earthen pot tied to his waist for keeping the catches. The net is held by means of the bamboo sticks at the ends and dragged along the marginal areas of rivers and in shallow waters. In dragging, the net forms a hollow in which the fry are collected during the operation. The common dip-net used is known locally as the *chakni jal*. It consists of a circular bamboo frame about 2 ft. to $2\frac{1}{2}$ ft. in diameter, to which is attached a very fine-meshed net which sags in the middle to form a deep bag. This net is used either as a typical dip-net (Plate, fig. 3), or as a drag-net by attaching a string to the frame where it touches the bottom and holding the opposite point of the frame with the other hand and dragging in shallow inundated areas (Plate, fig. 4). Sometimes a number of such dip-nets may be operated in a circle. Basu (1946) has described the use of the coarse cheese-cloth-like hand-woven towels (gamcha) for the capture of mullet fry. Pillay (1949) has also commented on this.

Where feasible, especially in rivers, mosquito netting stitched in the form of a *happa* (rectangular bag) can also be used, either as a stationary net where the current is strong, or as a drag-net where the current is feeble.

SEASONS OF OCCURRENCE OF FRY

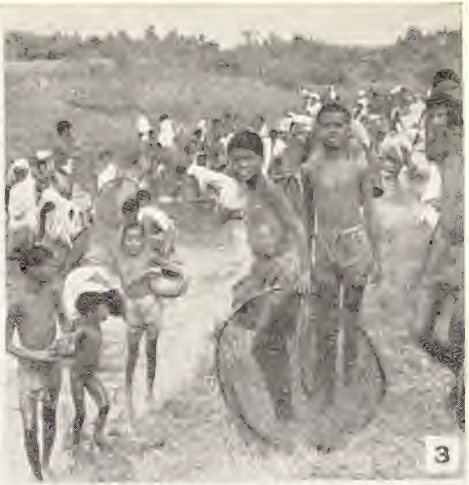
Five species of grey mullets are known to be present in the estuarine waters of West Bengal. Fry of one or more of these are present in the waters throughout the year.

The surveys undertaken during the present investigations have shown that fry of *M. parsia* are available in very large numbers all along the coastal and estuarine areas of Bengal from December-January to March; fry of *M. cunnesius* and *M. tade* from June-July to August-September and of *M. corsula* from August to October. Fry of *M. cephalus* are available, though not in abundance, in the coastal areas of Contai (Junput) and in the lower reaches of the Sundarbans from March to May.

KEY FOR THE FIELD IDENTIFICATION OF FRY OF BENGAL MULLETS

1.	Ventral profile of head arched	2
	Ventral profile of head not arched	4
2.	Dorsal and ventral profiles of body similar	3
	Ventral profile of body distinctly more convex than the dorsal profile	*M. corsula*
3.	Dorsal profile from first dorsal fin to tip of snout gradually declivitous	*M. parsia*
	Dorsal profile from first dorsal fin to orbit horizontal and from orbit to tip of snout declivitous and slightly convex ..	*M. tade*

1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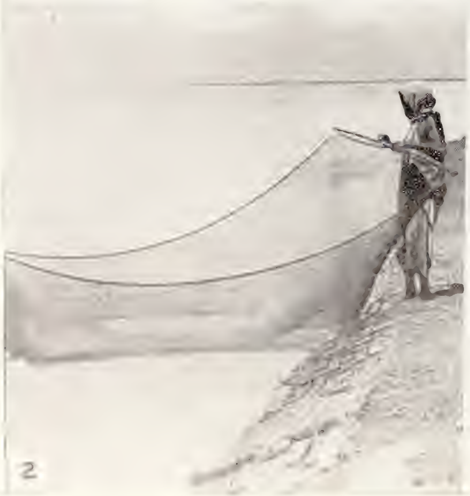
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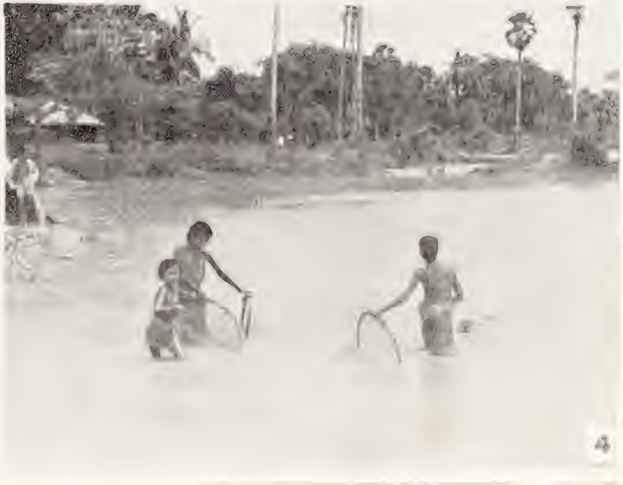
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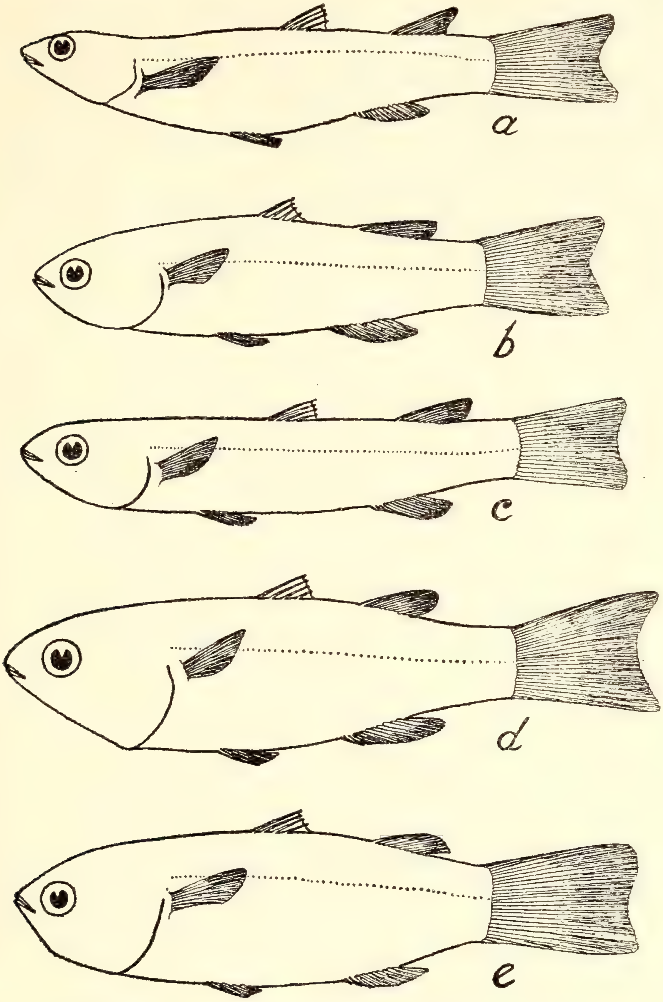
Fig. 1 :—The pools and puddles along the banks of a typical estuary at low tide, from where mullet fry can be collected in large numbers.

Fig. 2 :—The rectangular drag-net, *jnhaji jal*.

Fig. 3 :—The circular dip-net, *chakni jal*

Fig. 4 :—The circular dip-net *chakni jal* being operated as a drag-net.

4. Ventral profile of head steeply declivitous from tip of snout to opercle .. .. *M. cephalus*
Ventral profile of head from snout to orbit steep and angular, and arched thereafter .. .. *M. cunnesius*



Text-figure 1. The Common Mullet Fry of Bengal.

a. *Mugil corsula* 27 mm.
b. *Mugil parsia* 20 mm.
c. *Mugil tade* 20 mm.
d. *Mugil cephalus* 26 mm.
e. *Mugil cunnesius* 23 mm.

DESCRIPTION OF FRY

Mugil corsula Hamilton

The fry of this species are easily distinguishable by their slender rounded body, the characteristic profile, and the eyes which, though not so prominently bulging as in the adult, form a sufficiently reliable criterion for their identification. The dorsal profile from D_1 to the nape is gradually declivitous, after which it is more or less horizontal to the tip of the snout. Coloration is dull brown dorsally, extending to the sides, and dull white and somewhat silvery on the lower aspects. Fins are a uniform grey.

Proportionate measurements: Head 4.00-4.20 in total and 3.27-3.46 in standard length. Height of body contained 5.40-6.00 in total and 4.50-4.86 in standard length. Height of head about equal to its width and contained 1.83-2.10 in its length.

The characteristic bulging eyes of the adults are clearly manifest by the time the fry attain the fingerling stage.

Mugil parsia Hamilton

The fry of this species have no specially outstanding characteristics. The body is of medium height and thickness. The ventral profile of the head is arched. The coloration is light grey dorsally and silvery on the sides and on the ventral aspects. The outer edges of the fins are grey.

Proportionate measurements: Head 4.00-5.00 in total and 3.25-4.25 in standard length. Height of body 4.36-5.00 in total and 3.55-3.88 in standard length. Height of head greater than its width, being 1.33-1.57 times and 2.00-2.20 times respectively in length of head.

Mugil tade Forskal

The fry of *M. tade* are slender, and not quite so round in body as those of *M. corsula.* Dorsal and ventral profiles of the body are similar. The coloration is silvery with a tinge of grey on the back. The fins are uniformly tinged grey.

Proportionate measurements: Head, 3.90-4.75 in total and 3.50-3.90 in standard length. Height of body 4.86-5.66 in total and 4.00-4.67 in standard length. Height of head almost equals its width, being 1.60-1.90 in length of head.

The highly compressed head and pointed snout of the adult are clearly discernible in the fingerling stage.

Mugil cephalus Linnaeus

M. cephalus fry can be distinguished by the characteristic ventral profile and the comparatively thicker head. The dorsal profile from D_1 to behind the orbit is only very slightly declivitous, but is steeply so from the orbit to the snout. The proportionate height of the body is more than in any of the above species. The coloration is dark grey dorsally, greyish silver on the sides, and silvery on the ventral aspect. The fins are grey.

Proportionate measurements: Head 4.25-4.47 in total and 3.67-3.80 in standard length. Height of body 4.33-4.73 in total length and 3.58-3.69 in standard length. Height of head 1.5-1.60 in its length. Width of head less than its height and contained 1.78-1.88 times in its length.

Mugil cunnesius Valenciennes

The characteristic features of the fry of this species are the laterally compressed body and the ventral profile of head which is steep and angular from tip of snout to orbit and arched thereafter. The height of body is also more than for any of the other species described here. The dorsal profile from D_1 to nape of head is very gradually declivitous, after which it is somewhat more steep to the tip of the snout. The coloration is greenish olive dorsally, extending to about $\frac{1}{4}$ of the sides and silvery below, with a tinge of yellow. The fins are light and transparent. Fine pigment spots are arranged in rows along the myotomes on the body. These spots are not clearly visible in the living condition but can be discerned on freshly caught specimens and become very prominent some time after death and remain so when preserved in formalin.

Proportionate measurements: Head 4.36-4.73 in total and 3.10-3.64 in standard length. Height of body greater than length of head, being 4.00-4.08 in total and 3.08-3.09 in standard length. Height of head 1.10-1.22, and width of head 1.57-1.83 in its length.

The fingerlings have the characteristic features of the adults, such as the pointed axillary scale and the dark spot on the base of the pectoral. The arrangement of pigment spots along the myotomes is clearly evident in the fingerlings and at this stage the unpaired fins assume dark margins as seen in the adult.

EXPERIMENTS ON THE ACCLIMATISATION, CONDITIONING, AND TRANSPORT OF MULLET FRY

Divergent views have been expressed on the suitability of saltwater mullets for acclimatisation and culture in fresh water (Sarojini, 1951). The observations of Devanesan and Chacko (1943), Venkatraman (1944), Ganapati and Alikunhi (1949), Alikunhi and Jhingran (1951) support the view that mullets can be acclimatised easily by a careful process of gradual decrease in the salinity of the medium. Panikkar (1951) has commented on the high adaptability of mullets to lesser salinities and their suitability for culture. Hora and Nair (1944) and Spurgeon (1947) have referred to the migration of mullets from brackish waters into fresh water and their natural acclimatisation. Pillay (1949) has recorded the practice of direct transference of mullet fry caught from the sea at Contai into freshwater ponds by the fishermen in the area, in which the mortality was negligible. The experiments of Ganapati *et al.* (1950) have led them to the conclusion that mullet fry are very delicate and show a high percentage of mortality during 'acclimatisation, transport, and thereafter when stocked in fresh water'. Experiments in the acclimatisation, conditioning, and transport of fry of *M. parsia* were undertaken by the present author in order to ascertain how far this species can be utilised for culture in fresh water.

ACCLIMATISATION

Three series of laboratory experiments in the acclimatisation of fry collected from estuaries and sea to fresh water were conducted and the results of these experiments are summarised in Table I.

CONDITIONING AND TRANSPORT

Experiment 1

Fifty fry used in two of the experiments in acclimatisation in series No. III were transported in tube-well water (0.5‰ salinity) in two big earthen *handies* (capacity 10 litre) to Barrackpore. The fry were transported over a distance of 28 miles from Gosaba to Port Canning by boat, 28 miles from Port Canning to Calcutta, 14 miles from Calcutta to Barrackpore by train, and 3 miles from Barrackpore railway station to the laboratory by road. The entire distance was covered in about 8 hours. The mortality during transport was 6%.

The water in the containers was not changed during transport and the fry were not fed. At the laboratory they were transferred to chlorine-free tap water in glass aquaria, where they fed on growths of algae on stones, twigs, etc. kept in the aquaria. During the period of observation of one month there was no mortality.

Experiment 2

In this series was studied the effect of acclimatisation and conditioning on the viability of the fry to transport. Fry of *M. parsia* 15 mm. to 30 mm. long collected from the Bidyadhari River at Ghutiyari Sharif were used. Parallel experiments in transport were conducted with earthen *handies* and with tin carriers. In each case

TABLE I

Results of Experiments in the Acclimatisation of Mullet Fry

	Source of fry	Size range of fry (mm.)	No. of fry	Container used	Experimental jars		Control		Duration in hrs.	No. of replications	Mortality %			
					(1) $S^{\circ}/_{oo}$	(2) $S^{\circ}/_{oo}$	(3) $S^{\circ}/_{oo}$	(4) $S^{\circ}/_{o6}$			Jar (1)	Jar (2)	Jar (3)	Jar (4)
Series I	Sea (28 $S^{\circ}/_{oo}$)	15-25	30	glass jar (1 litre)	0.76	1.0	28	—	78	3	nil	nil	nil	—
II (a)	do	15-25	20	do	30	—	28	—	24	9	nil	—	nil	—
II (b)	The fry kept in 30 $^{\circ}/_{oo}$ salt solution in the previous experiment	15-25	20	do	0.76	1.0	30	28	90	3	nil	1.7	nil	nil
III (a)	estuary (26.8 $S^{\circ}/_{oo}$)	30-40	25	earthen handi (6 litre)	30	—	—	28	24	3	nil	—	—	nil
III (b)	Fry kept in 30 $^{\circ}/_{oo}$ salt solution in the previous experiment	30-40	25	do	1.1	0.5	30	28	72	3	nil	nil	1.3	nil

the quantity of water in the container was 22 litres. The results are tabulated in Table II.

TABLE II

Results of Experiments in the transport of Mullet Fry

State of fry transported	Medium	Salinity	No. of fry	Nature of container	Mortality at the end of the experiment	
					No.	Percentage
1. Conditioned	brackish water	28.6	300	earthen handi	8	2.7
2. Conditioned	brackish water	28.6	200	earthen handi	1	0.5
3. Conditioned	fresh water	0.89	200	earthen handi	3	1.5
4. Conditioned	brackish water	28.6	200	tin carrier	2	1.0
5. Conditioned	fresh water	0.89	200	tin carrier	1	0.5
6. Conditioned	brackish water	28.6	300	tin carrier	71	23.7
7. Not conditioned	brackish water	28.6	200	earthen handi	14	7.0
8. Not conditioned	brackish water	28.6	200	tin carrier	24	12.0

At the laboratory, the fry were released into cement cisterns containing chlorine-free tap water and kept under observation for a period of about a week during which they were found to thrive well.

Experiment 3:

For the purpose of this experiment *M. parsia* fry 15 mm. to 30 mm. long collected from the Hooghly River at Bhagbazar in Calcutta, were transported in earthen *handies* containing 20 litres of river water (salinity 0.4%). 250 fry were put in each *handi* and transported in a motor truck to the laboratory at Pulta over a distance of about 15 miles. The mortality was only 0.6%. A few preliminary experiments were also conducted in the laboratory on the survival rate and temperature tolerance of these fry and on their artificial feeding.

SURVIVAL OF MULLET FRY

The survival rate of *M. parsia* fry (10 mm. to 20 mm. long) collected from the Hooghly and transferred to chlorine-free tap water in aquaria was found to increase when they were given a saline bath (of about 1% sodium chloride) for about an hour before transfer to tap water. Even those fry which had become weak due to handling or due to the jolting during transport were found to revive under this treatment.

Preliminary laboratory experiments, conducted to determine the comparative influence of sodium chloride and calcium chloride on the survival of *M. parsia* fry in glass-distilled water, showed that, while the addition of small quantities of either increased the survival rate of fry, calcium chloride had comparatively more marked effect on survival than sodium chloride.

TEMPERATURE TOLERANCE

M. parsia fry (10 mm. to 20 mm. length) kept in tap water in glass jars were subjected to gradual rise in temperature of the medium from 28° C. to 40° C. in about 2½ hours in an incubator. The fry began to show signs of distress when the temperature reached 39° C. at the end of 2 hours, and began to die at 40° C. There was 100% mortality within ½ an hour after reaching the critical temperature of 40° C. even though there was no further rise in temperature.

When river water was used as medium instead of tap water, there was slight delaying of the distress symptoms but here also all the fry died within about 45 minutes after reaching the temperature of 40° C.

ARTIFICIAL FEEDING

M. parsia fry (10 mm. to 20 mm. length) kept in glass aquaria were found to feed avidly on micro-zooplankton and on the fine algal scum collected from the mud flats exposed at low tide on the banks of the Hooghly. The zooplankton consisted mainly of minute copepods and cladocerans, nauplii, rotifers, etc. The larger forms of copepods and cladocerans were not eaten by the fry. The algal scum consisted mainly of diatoms and small quantities of myxophyceae.

In all the countries of the Indo-Pacific region, where mullets are cultured on a large scale, rice-bran is extensively used as an artificial food for mullets in ponds. 10 mm.-20 mm. size group of *M. parsia* fry kept in glass troughs, however, did not take to this artificial diet. It has not been possible as yet to experiment with larger size groups of fry.

Fry of *M. parsia* of 10 mm. to 20 mm. length kept in aquaria were not found to be able to feed on filamentous algae, even when provided in a semi-decayed condition.

GENERAL REMARKS

The experiments demonstrate that fry of *M. parsia* can be directly transferred to fresh water without appreciable mortality, and that the laborious process of gradual reduction of salinity of the medium for acclimatisation is not necessary. The direct transfer of fry from sea water to freshwater ponds practised in pisciculture on the Contai coast (Pillay, 1949) has its parallel in the Diamond Harbour area (24-Parganas, West Bengal) where mullet fry collected from the estuary are directly introduced into freshwater ponds for culture along with carps. In view of these long standing traditional practices, the soundness of which is corroborated by the experiments mentioned above, they deserve to be demonstrated in other parts of the country. In the absence of suitable culture ponds the present author could not experimentally study the survival rate of acclimatised fry in ponds. The aquarium experiments, however, indicate that mullet fry can survive in fresh water with as much ease as they can be acclimatised. There is no reason to believe that a fish which can so easily acclimatise itself to fresh water would not survive if adequate food and other suitable environmental conditions are available.

With regard to the transport of mullet fry, it is noteworthy that there is less fry mortality when earthen *handies* in preference to tin carriers are used. The only drawback of *handies* is their liability to break easily during transport over long distances.

The percentage mortality was found to be less when the number of fry transported in the container was less, viz. 200 as against the larger number of 300. Though intermediate densities have not been tried, a ratio of about 200 fry to 22 litres (i.e. about 10 fry of 15 mm. to 30 mm. length to a litre) appears to be very suitable for transport over a duration of about 4½ hours. This density may be quite suitable for transport over longer distances also, but it may be necessary to change the water in the containers every 5 or 6 hours.

The preliminary survey of mullet fry resources in the State has shown that fry are available in abundance in coastal and estuarine areas. Fry of one species or the other can be collected at any time of the year. Small quantities of fry are collected for stocking freshwater ponds in certain areas of the State, besides the large quantities that are taken into the brackish-water *bheris* during high tides for cultural purposes. Due to the silting up of rivers many of the *bheris* in the upper Sundarbans do not get an adequate supply of fry. There is a definite need for augmenting the supplies by planting fry collected from rivers. In several districts, especially in the coastal and estuarine areas, there is great difficulty in procuring adequate quantities of carp spawn or fry for culture. Under these circumstances it will be desirable to expand the existing insignificant mullet fry trade in the State. Among the salt water mullets *M. cephalus, M. tade,* and *M. parsia* are species highly suited for cultivation. *M. corsula* which occurs both in salt water and fresh water is already a fairly popular cultivated fish, even though there is great difficulty in capturing them in ponds which cannot be drained. An organised trade in the fry of these species may serve to popularise the cultivation of mullets in the State.

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Studies on Cyprinid Fishes of the Oriental Genus *Chela* Hamilton

BY

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(*With two plates and six text-figures*)

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INTRODUCTION

Recently having had occasion to consider the nomenclatorial status of certain genera and species of freshwater fishes from India, it was found that the generic status and composition of *Chela*, the first division named by Hamilton (1822)[1] under the composite genus *Cyprinus*, was in confusion. Smith (1945) made a partial attempt to straighten the tangle, but writers seem still to adhere to earlier systems of classification, partly on account of Smith's work not being accessible as ready reference. Since 1945 some more literature has come out on the taxonomy of these fishes, and the present revision is therefore undertaken in order to help to avoid continuance of improper usage and to give an up-to-date classification of the fishes belonging to Hamilton's division *Chela*, which is now recognised as a distinct genus of the subfamily Abramidinae of the family Cyprinidae.

HISTORICAL RÉSUMÉ

Under the division *Chela* of the genus *Cyprinus*, Hamilton described a heterogenous assemblage of seven species. The first named species,

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[1] Also cited in earlier literature as Hamilton-Buchanan.

Cyprinus (*Chela*) *cachius* Hamilton was made the type of the genus *Chela* by Bleeker (1863, p. 215). The remaining six species, namely *Cyprinus* (*Chela*) *atpar*, *C.* (*Chela*) *laubuca*, *C.* (*Chela*) *phulo*, *C.* (*Chela*) *gora*, *C.* (*Chela*) *morar*, and *C.* (*Chela*) *bacaila*, are at present referable to at least three different genera. In view of Bleeker's restriction of *Cyprinus* (*Chela*) *cachius* as the type of *Chela*, the two species *C.* (*Chela*) *atpar* and *C.* (*Chela*) *laubuca* are also to be included under it. Of these two species, Hamilton's description conclusively shows that *C. atpar* represents adult specimens of *C. cachius*, which makes the former a synonym of the latter, as the specific name *cachius* has priority over *atpar*. That leaves two species, namely *cachius* and *laubuca*, from Hamilton's list of fishes that may be recognised as truly belonging to the genus *Chela*.

McClelland (1839) described a number of species, including Hamilton's species of *Chela* under the genus *Perilampus*, but did not indicate any type and this state of affairs lasted until Bleeker (1863, p. 258) designated *Perilampus devario* McClelland the type. The fact that *P. devario* McClelland is identical with *Cabdio devario* Hamilton, a species of the genus *Danio* Hamilton, makes *Perilampus* a synonym of *Danio*.

In describing a new genus *Laubuca*, Bleeker (1863) indicated McClelland's species *Perilampus guttatus* as the type ; but, the latter being a synonym of *Chela laubuca* Hamilton, *Laubuca* Bleeker automatically becomes a synonym of *Chela* Hamilton.

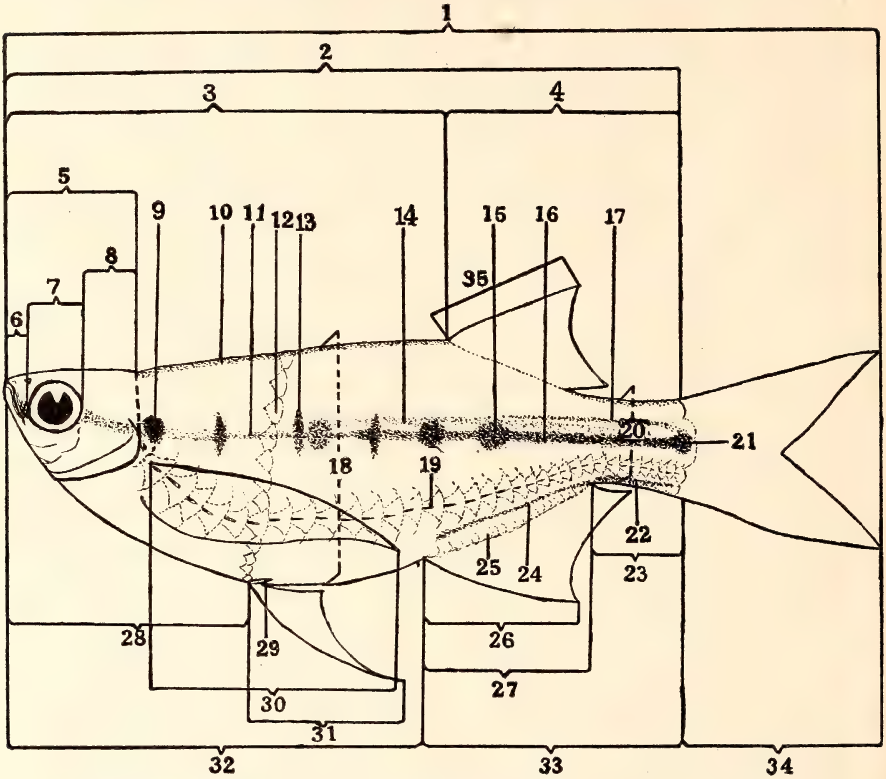
Günther (1868) described two new genera, the first *Eustira* with *Eustira ceylonensis* Günther as the type, and the second *Cachius* with *Chela atpar* Hamilton as the type. I have elsewhere (Silas, 1956) discussed reasons for considering *Eustira* Günther a synonym of *Danio* Hamilton. As already indicated, *Chela cachius* Hamilton replaces *Chela atpar* Hamilton, and this naturally makes *Cachius* Günther a synonym of *Chela* Hamilton.

Besides these, some of the species at present referable to the genus *Chela* Hamilton have been placed at one time or the other under the genera *Leuciscus*, *Paradanio*, etc. by Bleeker, Day, and other ichthyologists.

MATERIAL AND METHODS

i. Material :—The material examined includes both registered and unregistered specimens of the genus in the fish collection of the Zoological Survey of India, Calcutta ; five specimens of *Chela laubuca*, received on loan from the Colombo Museum, Ceylon ; the type and paratypes of *Laubuca siamensis* Fowler in the Academy of Natural Sciences, Philadelphia ; those in the collection of the U.S. National Museum, Washington D.C., and those collected by me from different parts of India, all being listed under the respective species.

ii. Methods :—Besides the standard measurements and counts generally adopted by ichthyologists, a few additional measurements and counts were made (Text-figure1). The predorsal distance is measured from the tip of the snout to the insertion of the first dorsal ray. The post-dorsal and post-anal distances are measured from the point of insertion of the first rays of these fins to the posterior end of the caudal peduncle, to which point also the standard length is measured from the tip of the snout. In measuring the length of the fins, the length of the



Text-figure 1.—Schematic drawing of a hypothetical *Chela* showing salient characters of external morphology and colour pattern. 1—total length; 2—standard length; 3—predorsal distance; 4—dorsal to base of caudal; 5—length of head; 6—length of snout; 7—diameter of eye; 8—post-orbital distance of head; 9—shoulder spot; 10—mid-dorsal stripe; 11—anterior part of the dark mid-lateral stripe; 12—transverse row of scales; 13—dark vertical stripe; 14—superficial lateral stripe; 15—Circular spots (when present situated along the dark mid-lateral stripe from the angle of the gill opening to below the dorsal fin); 16—posterior part of the dark mid-lateral stripe; 17—posterior part of the superficial lateral stripe; 18—height of body; 19—lateral line row of scales; 20—least height of caudal peduncle; 21—precaudal spot; 22—subpeduncular stripe; 23—Caudal peduncle; 24—supra-anal streak; 25—sheath of scales at base of anal fin; 26—length of longest anal finray; 27—length of base of anal fin; 28—preventral distance; 29—axillary scale; 30—length of pectoral fin; 31—length of pelvic fin; 32—pre-anal distance; 33—origin of anal fin to base of caudal fin; 34—length of caudal fin; 35—height of dorsal fin (length of longest ray).

longest ray from its base to the tip is taken. This is generally the last undivided ray of the dorsal and anal fins and the first ray of the pectoral and pelvic fins. The last branched dorsal and anal rays when divided to the base are also counted as single rays. The length of the caudal peduncle is measured from the posterior end of the base of the anal fin to the centre of the base of the caudal fin.

The predorsal scales are counted in a straight line between the occiput and the insertion of the first dorsal ray. In the enumeration of the number of lateral line scales, all the tube-bearing scales commencing from the upper angle of the gill-opening are counted. When the lateral line is absent or incomplete, the lateral linear scales are counted from the upper angle of the gill-opening to the base of the caudal fin in a straight line. The transverse line of scales are the number of scales in the oblique series between the mid-dorsal row and the origin of the pelvic fin and when expressed as follows: 7/1/3; 7-denotes the rows of scales above the lateral line, 1—the lateral line row, and 3—the scale rows between the lateral line and the origin of the pelvic fin.

iii. Terminology of colour pattern:—The importance of basic colour pattern in distinguishing species and subspecies among cyprinid fishes has been commented on in recent years by Hubbs and Raney (1947), Brittain (1954), and others. Forselius (1957) has drawn attention to the significance of colour markings and colour patterns in another group of freshwater fishes, the Anabantidae. The species of *Chela* when alive are more or less transparent but, when placed in formalin, they exhibit certain definite and characteristic colour patterns, an enumeration of which it is felt will be useful in such a revision. Besides individual variations, both juvenile and adult colour patterns differ to a certain extent, but the basic colour pattern in the adult form is more or less constant and hence may be used in specific and infraspecific distinctions. The golden and metallic blue reticulate colour markings in species of *Chela* seen on the sides of the anterior half of the body disappear shortly after the specimens are placed in the preservative and hence are not indicated in the accompanying figure. The basic colour patterns are indicated below and the terminology given will be used in the descriptions of the species.

a. Dark mid-lateral stripe (Figure 1 : 16) : This is a dark stripe found along the mid-lateral line of the body, but varying in extent and width in different species. In some it is confined only to the posterior part of the body, being more prominent on the caudal peduncle, while in others it extends in the form of a broad stripe up to the posterior margin of the orbit and from the anterior margin of the orbit to the angle of the mouth. In the live condition, this band appears to be superimposed by a metallic silvery band, a 'marking' which is lost when the specimen is placed in the preservative.

b. Superficial lateral stripe (Figure 1:17) : When present, this is confined to the posterior half of the body and is situated above the dark mid-lateral stripe. It is better defined on the caudal peduncle.

c. Mid-dorsal stripe (Figure 1:10) : This represents the dark stripe running from the occiput to the origin of the dorsal fin in some of the species. Rarely, in a less pronounced nature, it may also extend along the mid-dorsal line from the posterior end of the base of the dorsal fin to the base of the caudal fin.

d. Shoulder spot (Figure 1:9) : This is a dark black spot, situated behind the angle of the operculum above the base of the pectoral fin.

e. Dark vertical stripes (Figure 1:13) : These may be present in the form of 4 to 5 short vertical blackish stripes on the sides of the body above the pectoral fins.

f. Circular spots (Figure 1:15) : When present they are found along the dark mid-lateral stripe on the side of the body anteriorly.

g. Precaudal spot (Figure 1:21) : This represents a dark blotch, often diffuse, at the base of the caudal fin on the caudal peduncle.

h. Sub-peduncular stripe (Figure 1:22) : This represents a dark stripe running from the posterior end of the base of the anal fin to the caudal fin along the mid-ventral line of the caudal peduncle.

i. Supra-anal streak (Figure 1:24) : This represents a row of black pigment spots which takes the form of a narrow streak running more or less parallel to the base of the anal fin below the lateral line.

Besides these, the fins are sometimes dusky or dirty white and in some species are also tipped with grey.

SYNONYMS OF THE GENUS *CHELA* HAMILTON

Chela Hamilton, 1822, Fish. Ganges, pp. 258, 383 (Type : *Cyprinus* (*Chela*) *cachius* Hamilton, as restricted by Bleeker).

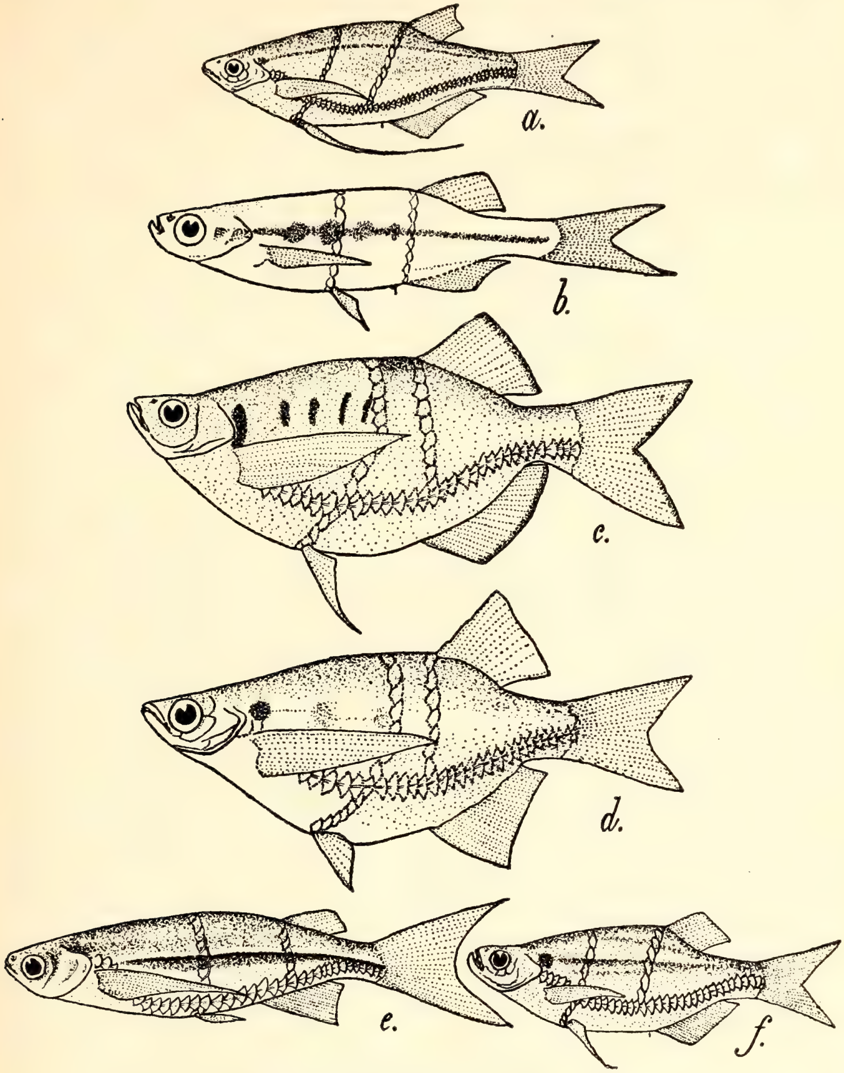
Laubuca Bleeker, 1860, *Ichth. Archipel. Indici, Prodr.*, **2**, *Cyprini.* (Type : *Perilampus guttatus* McClelland = *Cyprinus* (*Chela*) *laubuca* Hamilton).

Cachius Günther, 1868, *Catal. Fish. Brit. Mus.*, **7** : 339 (Type : *Cachius atpar* (Hamilton) = *Cyprinus* (*Chela*) *cachius* Hamilton).

DEFINITION OF THE GENUS *CHELA* HAMILTON

In addition to the Indian and Thailand species of *Chela* that I have examined, the excellent descriptions of the Sumatran and Thailand species given by Weber and de Beaufort (1916) and Smith (1931, 1945) respectively have helped in drawing up the following redescription of the genus:

Fishes of the genus *Chela* Hamilton are small in size being less than about three inches in standard length and found frequenting streams, tanks, and ponds. The body is almost always strongly compressed, deep or moderately so, and the abdominal edge is partly or almost wholly cultrate. In some species the abdomen is cultrate only between and behind the pelvic fins and backwards up to the vent. The mouth is



Text-figure 2.—Outline drawings of six *Chela* species showing some diagnostic characters. (*a*) *Chela* (*Chela*) *cachius* Hamilton; (*b*) *Chela* (*Neochela*) *dadyburjori* (Menon); (*c*) *Chela* (*Chela*) *caeruleostigmata* (Smith); (*d*) *Chela* (*Chela*) *mouhoti* Smith; (*e*) *Chela* (*Allochela*) *maassi* (Weber & de Beaufort); (*f*) *Chela* (*Chela*) *laubuca* Hamilton. Figures *a* & *f* are after Day (1878); *b* after Menon (1952); *c* & *d* after Smith (1945) and *e* after Weber & de Beaufort (1916). Full scalation is not shown.

small and is directed obliquely or almost vertically upwards. The cleft of the mouth reaches to a vertical below the anterior margin of the eye or is far removed from it, but never extends to beneath or behind the eye. The eyes are large and are placed more in the anterior half of the head. A symphysial knob or hook is absent in the lower jaw. The barbels are totally absent. The lateral line is either complete, incomplete, or absent; when complete, it curves more or less abruptly downwards towards the pectorals and runs along the lower half of the body, terminating in the lower half of the base of the caudal fin. The scales along it number 30 to 66. When incomplete, the lateral line pierces only a few of the anterior scales. The predorsal scales commence from the occiput, far behind the eyes. An anal sheath consisting of a row of scales is present. The dorsal fin is situated completely opposite the anal fin and its point of origin is never ahead of that of the latter. The dorsal fin is short, with 9 to 13 rays of which the first two or three rays are simple and unbranched, the last undivided ray being weak and articulated. The pectoral fins are long and pointed, the length of each fin being much greater than the length of the head. The pectorals generally extend considerably beyond the origin of the pelvic fins. The pectoral fin is provided with 9 to 13 rays, of which the outermost ray is undivided and elongate. In addition two or three short undivided rays may be present at the inner angle of the pectoral fin in certain species. The pelvic fin has 5 to 7 rays, of which the outer undivided ray is elongated and filamentous in some of the species. The anal fin is long or moderately so and possesses 13 to 26 rays of which the first two or three rays are undivided. The caudal fin is forked and has 17 to 19 complete rays; the caudal lobes are pointed and equal or slightly subequal in length. The gill-openings extend on the ventral surface to almost below a vertical from the eye. The pharyngeal teeth are arranged in three rows as 5, 4 or 3, 2 or 1/1 or 2, 3 or 4, 5, and are uncinate. Branchiostegeals number 3. The air-bladder is bipartate, the posterior chamber being the larger. The body coloration differs in the different species.

Distribution:—Ceylon, India, Pakistan, Burma, Thailand, Malaya, and Sumatra.

AFFINITIES OF THE GENUS *CHELA* HAMILTON

Although this settles the question of the generic status and validity of Hamilton's division *Chela*, the fact that earlier workers (Günther 1868 ; Day 1878 ; Weber and de Beaufort 1916, and others) have erroneously included under it species which at present have to find a place elsewhere has necessitated further clarification. Smith (1945) favoured the use of the name *Oxygaster* van Hasselt as being valid for the species other than *Chela* included by the above mentioned authors under the latter. In 1951 I gave a list of the Indian species of the genus *Chela* (=*Oxygaster* van Hasselt), but it is now evident that all the Indian species mentioned therein cannot be included under *Oxygaster*, as that genus is restricted at present. However, for the time being it is proposed to retain those species under *Oxygaster*, until a revision of them, which is very badly needed, is undertaken. In *Oxygaster* s. str., as in *Chela* Hamilton, the body is greatly compressed and the abdomen is cultrate, but the following characters help to distinguish the two genera :

Predorsal scales extending to interorbital space ; lateral line gently curved downwards above pectorals ; a symphysial knob in lower jaw fitting into a corresponding emargination of upper jaw present .. .. *Oxygaster*
Predorsal scales not extending to interorbital space ; lateral line curved more or less abruptly downwards above pectorals ; a symphysial knob or hook absent in lower jaw .. *Chela*

In addition to these, at least 24 genera of the subfamily Abramidinae are recognised at present from south-east Asia, although the status of some of them as well as those proposed by earlier workers and at present relegated as synonyms needs elucidation. The relationships of *Chela* to the different genera recognised at present are discussed here.

The absence of predorsal scales in the interorbital space and a symphysial knob or hook in the lower jaw help in distinguishing *Chela* from *Macrochirichthys* Bleeker, a genus closely allied to *Oxygaster* van Hasselt. In the absence of barbels, *Chela* differs from *Nematabramis* Boulenger, a genus characterised by the presence of a pair of long maxillary barbles and at present known from the East Indian Archipelago. Although, as in *Chela*, the dorsal fin in the Thailand and Bornean genus *Parachela* Steindachner is placed opposite the anal fin, the absence of pelvic fins in the latter serves to distinguish it from the former. In this connection it may be mentioned that the presence or absence of pelvic fins as constituting a character of generic importance has been questioned by some workers in other groups of fishes (e.g. Cyprinodontiformes and Ophicephaliformes). Even if this character were to be dropped, *Parachela* may still have to be kept apart as a separate genus on account of (i) the symphysial knob it possesses and (ii) the very long anal fin it has with 30 to 35 branched rays.

The position of the dorsal fin in *Chela* (opposite and never ahead of the anal fin) and the absence of a symphysial knob in the lower jaw help in separating it from the genera *Longiculter* Fowler from Thailand, *Paralaubuca* Bleeker from Thailand and the Malaya Archipelago, *Cultrops* Smith from Thailand, and *Rasborichthys* Bleeker from Malaya

Archipelago and Indo-China. *Longiculter* Fowler also differs from *Chela* in the possession of biserial instead of triserial pharyngeal teeth.

The situation of the dorsal fin opposite the interspace between the pelvic and anal fins and rarely extending over the anal fin serves as a diagnostic character in separating the Chinese genera *Hemiculter* Bleeker, *Cultriculus* Oshima, *Anabarilius* Cockerell (= ? *Ischikauia* Jordan and Snyder), *Metzia* Jordan and Thompson, *Rohanus* Chu, *Parapelucus* Günther, *Pseudolaubuca* Bleeker, *Toxabramis* Günther, *Hemiculterella* Warpachowski, *Chanodichthys* Bleeker, *Culter* Basilewasky, *Parabramis* Bleeker, *Megalobrama* Dybowski, *Luciobrama* Bleeker, *Nicholsiculter* Rendahl, etc. from *Chela*, where the origin of the dorsal fin is never in advance of that of the anal fin. Other equally important characters, such as the biserial instead of the triserial pharyngeal teeth (e.g. *Toxabramis* Günther, *Hemicultrella* Warpachowski), the terminal or subterminal instead of the obliquely vertical or almost vertical mouth (e.g. *Parabramis* Bleeker), the dorsal fin with the first one or two rays spinous instead of non-osseous, weak, undivided, and articulated (e.g. *Culter* Basilewasky, *Hemiculter* Bleeker, and *Toxabramis* Günther, where the dorsal spine is serrated in two rows), etc., help in separating the Chinese genera from *Chela*.

It may be mentioned here that the Asiatic genera at present placed under the subfamily Abramidinae exhibit such diverse affinities that it would seem that the grouping is one more of convenience than a natural assemblage. Some of the genera show considerable affinities to the Leuciscinae and the Rasborinae, while the systematic position of certain others needs clarification. However, it is interesting to note that *Chela* is more akin to the other Abramidinae found in Thailand and the Malayan Sub-Region, than to those found in China. In fact, the differences between the Chinese and the remaining south-east Asiatic genera of Abramidinae appear to be rather very well marked.

SUBDIVISIONS OF THE GENUS *CHELA* HAMILTON

Attempts have been made in the past to subdivide the genus *Chela* into two or more groups or subgenera. In 1916, Weber and de Beaufort recognised *Eustira* Günther as a subgenus of *Laubuca* Bleeker (= *Chela* Hamilton) and remarked :

> ' We do not think that the genus *Eustira* Günther is generically distinct from *Laubuca* ; we therefore give it only the value of a subgenus ; containing *Eustira ceylonensis* Gthr. and our *Eustira maassi*'.

Eustira was distinguished from *Laubuca* on the nature of the lateral line ; it being gently curved downwards in *Laubuca* s. str., and abruptly curved downwards in the former. I have elsewhere shown that *Eustira* Günther is a synonym of *Danio* Hamilton (Silas, 1957) and the subgenus of *Laubuca* to which Weber and de Beaufort assigned the name *Eustira* is thus left without a valid name.

In this connection, I have looked into the desirability of subdividing the genus and find that the species may be more conveniently grouped under three subgenera, two of which are proposed here as new.

Attention may be drawn to the fact that the character chosen earlier for subdividing the genus, namely whether the lateral line is gently curved down or abruptly curved down, may not be of primary importance, for, when compared to certain genera of the subfamily Abramidinae, such as *Oxygaster*, *Macrochirichthys*, *Rasborichthys*, *Chanodichthys*, *Culter*, etc., the lateral line in *Chela*, *Cultriculus*, and certain other cultrid genera is definitely more sharply curved downwards from above the pectoral fin. This appears to be the condition in all the species of *Chela* with complete lateral line like those I have examined; at the same time, the distance between the lateral line and the mid-ventral line or the origin of the pelvic fin, when expressed as number of rows of scales, differs in the different species, which definitely fall into two natural groups. Hence, this is considered here as one of the characters for subdividing the genus.

In distinguishing genera and subgenera of the subfamilies Abramidinae and Rasborinae, due consideration is given to whether the lateral line is complete, incomplete, or absent. There is only one species of *Chela* in which the lateral line is incomplete or absent, and in this respect it occupies a unique position, on account of which it is relegated under a separate subgenus. In addition to the importance of the nature of the squamation in recognising natural groups in the genus *Chela*, the greatest depth of the body and the number of anal fin rays are additional characters for separating the species which fall into three subgenera as follows :

I. *Chela* (sensu stricto): Lateral line complete; 2½ (generally 3+) to 6 rows of scales between lateral line and base of pelvic fin ; 11 to 17 rows of scales in a transverse series from the mid-dorsal row to the base of the pelvic fin occurring as : 6-12/1/2½-6 ; anal fin with 19 to 26 rays of which the first two or three rays are simple and undivided; (the greatest height of the body is contained 2.15 to 4.1 in the standard length).

Two species groups of *Chela* s. str., are recognised here as follows :

1. *Cachius*-group

Scales smaller, much more numerous on the body ; lateral line with 51 to 66 scales ; scale rows above lateral line 9 to 12; predorsal scales 23 to 29.

The genotype, *Chela* (*Chela*) *cachius* Hamilton, belongs to this species-group.

2. *Laubuca*-group

Scales relatively larger; lateral line with 31 to 37 scales; scale rows above lateral line 6 to 9 ; predorsal scales 15 to 21.

The following three species belong to this species-group :

Chela (*Chela*) *laubuca* Hamilton
Chela (*Chela*) *caeruleostigmata* (Smith)
Chela (*Chela*) *mouhoti* Smith

II. *Allochela* (New subgenus) : Lateral line complete ; not more than two rows of scales between lateral line and base of pelvic fin ; 9 to 10 rows of scales in a transverse series from the mid-dorsal row to base of pelvic fin occurring as 6-7/1/1-2; anal with 13 to 18 rays of which the first three rays are simple and undivided ; (the greatest height of the body is contained 3.3 to 4.3 in the standard length).

Chela (*Allochela*) *fasciatus* subgen. et sp. nov. (Designated as the type of the new subgenus)
Chela (*Allochela*) *maassi* (Weber and de Beaufort)

III. *Neochela* (New subgenus) : Lateral line incomplete or absent ; 7 or 8 rows of scales in a transverse series from the mid-dorsal row to the base of the pelvic fin ; anal with 14 to 15 rays of which the first three rays are simple and undivided ; (the greatest height of the body is contained 4.0 to 5.16 in the standard length).

Chela (*Neochela*) *dadyburjori* (Menon)
(Designated as the type of the new subgenus)

Synopsis to the Identification of the Subgenera and Species of the Genus *CHELA* Hamilton

I. Lateral line complete.

A. 11 to 17 rows of scales in a transverse series from mid-dorsal row to base of pelvic fin occurring as 6-12/1/2½-6; anal fin with 19 to 26 rays of which the first two or three rays are simple and undivided (*Chela* s.str.)

1. Scales in lateral line 51 to 66 ; scale rows above lateral line 9 to 12 ; predorsal scales 23 to 29.. *Chela* (*Chela*) *cachius* Hamilton

2. Scales in lateral line 31 to 37 ; scale rows above lateral line 6 to 9 ; predorsal scales 15 to 21.

a. Greatest height of body 2.8 to 3.6 in standard length; anal rays 2/17-18 (a dark shoulder spot and precaudal spot, both connected by the narrow dark lateral stripe, sometimes not so clearly defined in the anterior half of the body. .. .. .. *Chela* (*Chela*) *laubuca* Hamilton

b. Greatest height of body 2.15 to 2.25 in standard length ; anal rays 2/22-23... ..

i. Scales in lateral line 34 to 35 ; 8 to 9 rows of scales above lateral line and 3 to 5 rows between it and base of pelvic fin ; 12 to 13 rows of scales round caudal peduncle ; shoulder spot blackish green ; 4 to 5 short dark vertical stripes above pectoral fins on sides of body. .. .. .. *Chela* (*Chela*) *caeruleostigmata* (Smith)

ii. Scales in lateral line 31 ; 7 rows of scales above lateral line and 5 rows between it and base of pelvic fin ; 14 rows of scales round caudal peduncle ; conspicuous round blackish shoulder spot ; no dark vertical stripes. .. .. .. *Chela* (*Chela*) *mouhoti* Smith

B. 9 to 10 rows of scales in a transverse series from mid-dorsal row to base of pelvic fin occurring as 6-7/1/1-2 ; anal fin with 13 to 18 rays of which the first 3 rays are simple and undivided (*Allochela* subgen. nov.).

1. Anal fin-rays 3/14-15 ; predorsal scales 18 ; (peninsular India) .. .. .. *Chela* (*Allochela*) *fasciata* sp. nov.

2. Anal fin-rays 3/10 ; predorsal scales 20 ; (Sumatra) .. .. *Chela* (*Allochela*) *maassi* Weber and de Beaufort

II. Lateral line incomplete or absent (*Neochela* subgen. nov.).

(Lateral line absent or when present piercing only a few anterior scales) .. .. .. *Chela* (*Neochela*) *dadyburjori* (Menon)

SYSTEMATIC ACCOUNT

As this revision is aimed at indicating the precise specific limits of the different species, opportunity is also taken to draw attention to variations that may be expected to occur within species limits or certain characters of those species of which material is available. It has been possible to carry out a detailed study of *Chela* (*Chela*) *laubuca* from samples from different geographical areas along its range of distribution and the results point to a certain amount of correlation between the variations observed in the body proportions, fin ray and scale counts, and the geographical location, in some cases of sufficient magnitude to recognise geographical races or subspecies. These trends are indicated here.

Genus **Chela** Hamilton

Subgenus CHELA *s. str.*

Cachius-group

Chela (Chela) cachius Hamilton

(Text-figure 2, *a*)

Cyprinus (*Chela*) *cachius* Hamilton (Buchanan), Fish. Ganges, pp. 258, 384 (1822). Type locality : River Ganges, about the commencement of the Delta. Type not preserved.

Cyprinus (*Chela*) *atpar* Hamilton (Buchanan), Fish. Ganges, pp. 259, 384 (1822). Type locality : Branches of the Ganges, the Jumna, and the Brahmaputra rivers. Type not preserved.

Chela atpar Gray, Ill. Indian Zool., pl. xcvi, fig. 2 (1834).

Perilampus psilopteromus McClelland, *Asiat. Res.* **19**, pp. 289, 396 (1839). Based on Hamilton's description of *Cyprinus atpar* and MS. drawing of *Cyprinus loyukula*. Locality : Bengal.

Perilampus cachius McClelland, *Asiat. Res.* **19**, pp. 290, 396, pl. xlvi, fig. 4 (1839). From Hamilton's MSS.

Chela anastoma Swainson *Nat. Hist. Fish. etc.* **2**, p. 258 (1839). After the drawing of *C. atpar* given by Gray, from Hamilton's collection.

Cyprinus atpar Valenciennes, *Hist. Nat. Poiss.* **16**, p. 454 (1842).

Cyprinus kachius Valenciennes, *Hist. Nat. Poiss.* **16**, p. 453 (1842). After Hamilton's *C. cachius*.

Perilampus macropodus Jerdon, *Madras Journ. Litt. & Sci.* **15**, p. 325 (1849). Type locality : Cauvery River near its source in Coorg, south India.

Leuciscus cachius Bleeker, *Verh. Batav. Genootsch.* **25**, p. 66 (1853).

Leuciscus atpar Bleeker, *Verh. Batav. Genootsch.* **25**, p. 66 (1853).

Paradanio elegans Day, *Proc. Zool. Soc. London*, p. 297 (1867). Type locality : Bowany river (Tributary of the Cauvery river), south India.

Cachius atpar Günther, *Catal, Fish. Brit. Mus.* **7**, p. 339 (1868).

Perilampus atpar Day, Fish. India **2**, p. 598, pl. cli, fig. 6 (1878) ; *Fauna Brit. India, Fish*, p. 359 (1889) ; Fowler, *Proc. Acad. Nat. Sci. Philadelphia* **76**, p. 73 (1924).

Perilampus cachius Raj, *Rec. Indian Mus.* **12**, p. 261, (1916).

D. 2/7-8 ; P. 1/8-11 ; V. 1/4-5 ; A. 2-3/19-23 ; L.1. 51-66 ; L. tr. 9-12/ 1/3-5

Description: The head is contained 4.44 to 5.77 in the total and 3.5 to 4.44 in the standard length. The height of the body is about 4.0 to 5.83 in the total and 3.25 to 4.6 in the standard length. The width of the body is contained about 9.75 to 12.75 in the total and 7.66 to 10.0 in the standard length. The mouth is slightly oblique, the cleft not extending to below the anterior margin of the eye. The height of the head at occiput is contained 1.3 to 2.0 ; the width of the head 1.57 to 2.33

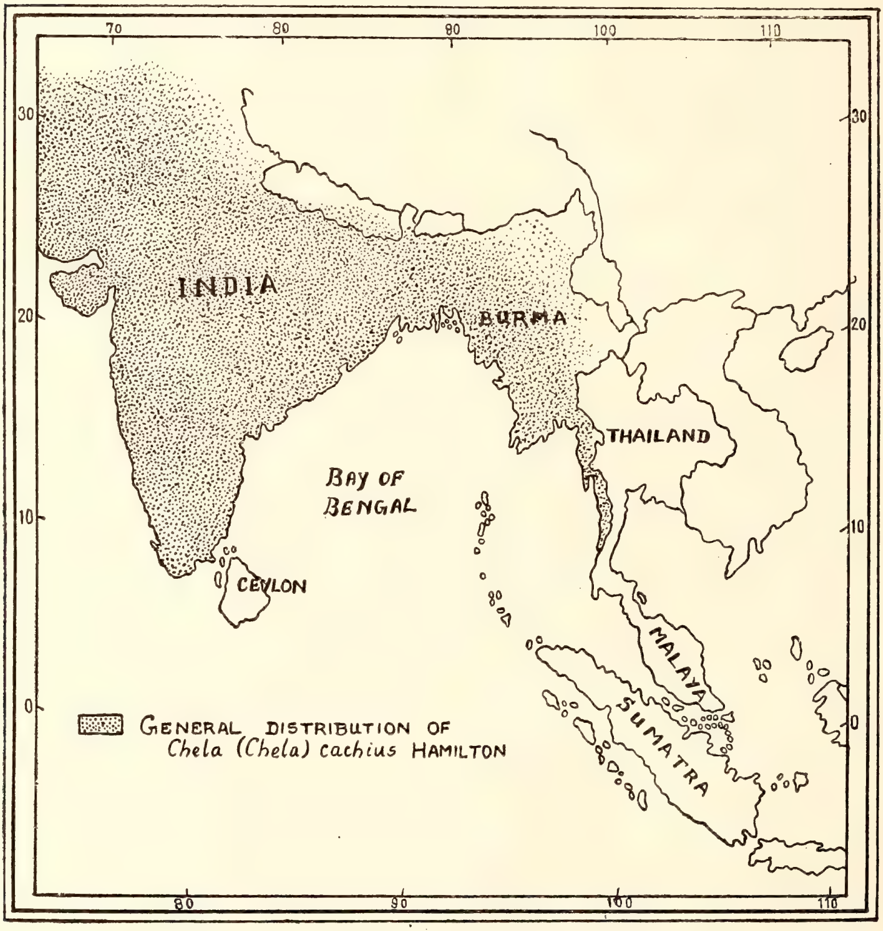
and the length of the snout 3.2 to 5.5 in the head length. The eye is situated much closer to the tip of the snout than to the posterior margin of the head and its diameter is contained 2.75 to 4.00 in the head length ; 0.66 to 1.0 in the snout length and 1.16 to 2.0 in the interorbital distance. The last said is contained about 1.75 to 2.57 in the head length, which in turn is contained 0.83 to 1.27 in the greatest height of the body. The height of the body is proportionately greater in larger examples. The caudal peduncle is longer than deep, its least height being contained 1.2 to 1.75 in its length.

The distance from the tip of the snout to the origin of the dorsal fin is contained 1.35 to 1.62 ; the origin of the dorsal to the base of the caudal fin 2.34 to 3.1 ; the tip of the snout to the origin of the anal fin 1.35 to 1.8 ; the origin of the anal fin to the base of the caudal fin 1.8 to 2.85 ; the tip of the snout to the origin of the pelvic fin 2.58 to 3.37, and the distance from the origin of the pelvic fin to the base of the caudal fin 1.29 to 1.54 in the standard length. The distance from the tip of the snout to the origin of the dorsal fin is 1.47 to 2.0 times the distance from the origin of the dorsal fin to the base of the caudal fin ; the tip of the snout to the origin of the anal fin 1.21 to 1.71 times the origin of the anal fin to the base of the caudal fin and the origin of the pelvic fin to the base of the caudal fin 1.8 to 2.71 times the distance from the tip of the snout to the origin of the pelvic fin.

The height of the dorsal fin is contained about 1.1 to 1.9 in the greatest height of the body. The paired fins are much longer than the head and the pectoral extends considerably beyond the origin of the pelvic fin. The pectoral fin is 1.1 to 1.5 times and the pelvic fin is 1.14 to 2.1 times longer than the head. The outer pelvic fin ray is elongated into a filamentous process, which reaches usually as far back as the posterior third of the anal fin. The longest anal fin ray is slightly shorter than the length of the head. The caudal fin is a little longer than the head, its length being contained 4.0 to 5.4 in the total and 2.87 to 4.44 in the standard length. The abdomen is keeled only between and behind the pelvic fins. The pelvic fin in *cachius* is situated considerably forward than in the other species.

The lateral line scales range from 51 to 66, while the predorsal scales number 23 to 29. There are 15 to 17 rows of scales round the narrowest part of the caudal peduncle. 3 to 5 rows of scales are present between the lateral line and the origin of the pelvic fin in an oblique series and 9 to 12 rows between the lateral line and the mid-dorsal row along the deepest part of the body.

No conspicuous colour markings are present in this species. When alive the specimens are more or less transparent. Formalin-preserved specimens show the following characteristics. The dark lateral stripe is greatly reduced to a narrow black streak running from the upper angle of the gill-opening and extending to about four scales away from the base of the caudal fin. A conspicuous shoulder spot is absent, but a few black pigment spots occur about the base of the pectoral fin. The superficial lateral stripe is represented as a narrow pigmented lighter band above the dark lateral streak. It is more or less clear up to a vertical above the middle of the pectoral fin, but anteriorly it becomes very light. The mid-dorsal stripe is narrow, greyish brown, and runs from the occiput to the base of the caudal fin. The supra-anal streak is present, though not very pronounced. Dark minute pigment spots are present in all the fins giving them a light greyish colour. The scales on the upper half of the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INDIA
BURMA
THAILAND
BAY OF BENGAL
CEYLON
MALAYA
SUMATRA
▨ GENERAL DISTRIBUTION OF *Chela (Chela) cachius* HAMILTON

Text-figure 3.—Map showing the general distribution of *Chela* (*Chela*) *cachius* Hamilton.

body are edged dark greyish brown while those on the lower half of the body are silvery. The supra and infra orbital margins are coloured black.

Distribution: India, Nepal, Pakistan, and Burma.

General Remarks: The redescription of *cachius* given above is based on material examined by me from India. There appears to be an increase in the fin ray counts, lateral line scales, etc. in specimens from north India when compared to those from peninsular India. Correlation in these and other morphometric characters in relation to the latitude in which the species is found may eventually lead to the recognition of geographical races or subspecies. That being the case, in addition to the discussion on the synonyms, it is not out of place to consider here the availability of names already in existence which are now placed in the synonymy of the species for future subspecific designation.

That *cachius* and *atpar* are one and the same is now clear from Hamilton's description and drawings of the species and also from the material before me. Gray (1834) published a drawing of *atpar* from Hamilton's collection (pl. xcvi, fig. 2 of *Ill. Indian Zool.*, 2) and this was designated later by Swainson (1839) as *Chela anastoma. Perilampus psilopteromus* McClelland is based on Hamilton's description and figure of *C. atpar.* McClelland mentions one other name, *C. loyukula*, from Hamilton's collection in the synonymy of *psilopteromus* and there is no mention of *loyukula* in subsequent works. There are discrepancies in the descriptions and Hamilton's drawing of *atpar*, and this is specially so in the depiction of the scalation, which may lead one to confuse the drawing of *atpar* with that of *laubuca*! There are numerous instances in Hamilton's work, where such differences between the description and the drawing can be pointed out, and in this case *atpar* is shown as possessing lesser number of scales on the body. But the absence of the characteristic shoulder spot of *laubuca*, the considerably elongate pelvic fin, and the more forward insertion of the latter should easily help in distinguishing Hamilton's drawing of *atpar* (=*cachius*) from that of *laubuca.*

Perilampus macropodus Jerdon, from the headwaters of the Cauvery river near Coorg, is no doubt referable to the synonymy of *cachius*, although Günther (1868) placed it as a doubtful species under the genus *Danio* Hamilton. Jerdon's description of *macropodus* is brief, but the following characters namely, ' Pectoral fin long ; ventral fin with the 1st ray longer than pectoral ; green above, silvery beneath, fins yellowish . . . . . ' help in separating it from *laubuca* which also occurs in the Cauvery. In 1867, Day described a new species, *Paradanio elegans* from the Bowany river, a tributary of the Cauvery, but later (1872) rightly relegated it to the synonymy of *atpar.* Jerdon's *macropodus* and Day's *elegans* are from the same watershed and are identical. In view of this, as already noted, if any subspecies of *cachius* is recognised from the Cauvery watershed, the availability of the name *macropodus* which has priority over *elegans* is pointed out here.

Material examined:[1] 222 specimens from the Bhavani River, tributary of the Cauvery River, south India, collected by S. Rajan ; 2 specimens from a stream on the Sagar-Shimoga Road, Shimoga Dt., Mysore (Z.S.I. No. F. 12374/1) ; 1 specimen from Tunga River at Shimoga, Mysore (Z.S.I. No. F. 12375/1) ; 41 specimens from the Bhadra River at Bhadravati, Shimoga Dt., Mysore (Z.S.I. No. F. 12376/1) ; 4 specimens from the Tunga River at Shimoga, Mysore (Z.S.I. No. F. 12377/1) ; 11 specimens from Mahanadi River before its junction with the Balka Nallah about 3 miles from Sihawa, Orissa, collected on 14-12-1939 (Z.S.I. No. F. 13144/1) ; 12 specimens from Balka Nallah about 3 miles from Sihawa, Orissa, collected on 14-12-1939 (Z.S.I. No. F. 13145/1) ; 1 specimen from Mahanadi irrigation canal, Rudri, Orissa (Z.S.I. No. F. 13146/1) ; 1 specimen from Dr. F. Day's collection from Orissa (Z.S.I. Cat. No. 914) ; 1 specimen from Goalpara, collected by H. S. Higston (Z.S.I. Cat. No. 912) ; 1 specimen from Dr. F. Day's Collection from Sind (Z.S.I. Cat. No. 2478) ; 2 specimens collected by C. Pavia from Shalimar Gardens, Lahore, W. Panjab (Z.S.I. No. F. 9603-4/1) ; 1 specimen collected by F. M. Bailey from Tribani, Nepal (Z.S.I. No. F. 12266/1); 2 specimens from Nulla Katiar, Karachi District, Pakistan (B.N.H.S. No. 446-2 : the specimens are badly damaged) ; 1 specimen collected by Maj. N. Murphy from Jati, Karachi Dt., Pakistan (B.N.H.S. No. 446-3 : specimen badly damaged).

Vernacular Names: *Kachhi* (Bengali) after which the species name *cachius* was coined by Hamilton ; Day (1872) mentions that in Oriya the species is known as *Bonkuaso* and in Burmese as *Nga-man-dan* or *Ya-paw-nga* or *Nga-phyin-gyan*.

Laubuca-group

Chela (Chela) laubuca Hamilton

Cyprinus (*Chela*) *laubuca* Hamilton (Buchanan), Fish. Ganges, pp. 260, 384 (1822). Type locality : Ponds in northern parts of Bengal.

Perilampus guttatus McClelland, *Asiat. Res.* **19**, pp. 289, 394, pl. xlv, fig. 4 (1839) (erroneously marked pl. lvi, fig. 10 ; from Hamilton's MSS.).

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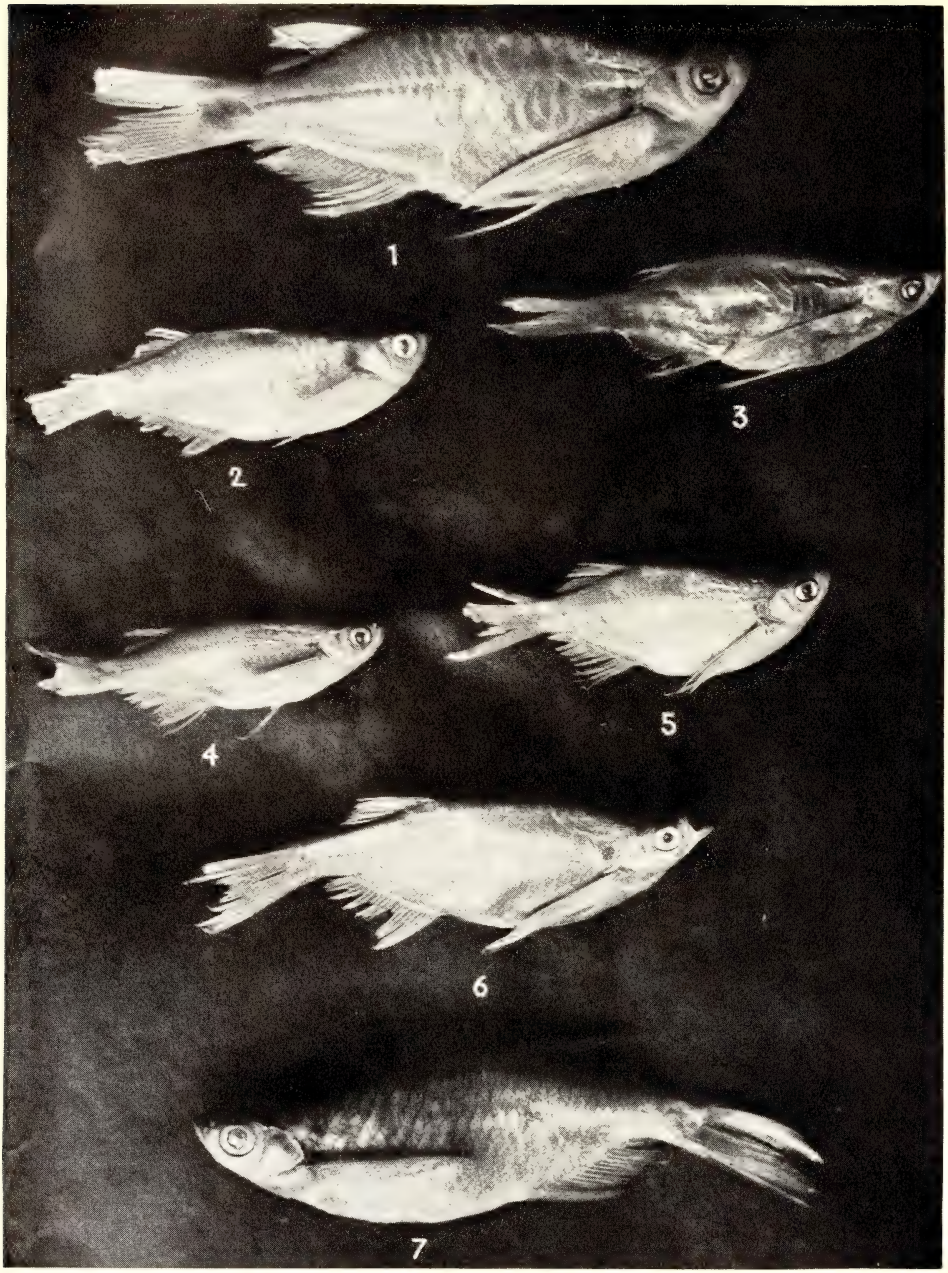
[1] Under ' Material examined ' the undermentioned abbreviations stand for :

Z.S.I. = Zoological Survey of India, Calcutta.
B.N.H.S. = Bombay Natural History Society, Bombay.
U.S.N.M. = United States National Museum, Washington D.C.
A.N.S.P. = Academy of Natural Sciences, Philadelphia.
C.M. = Colombo Museum, Ceylon.



Chela (*Chela*) *laubuca* Hamilton

Specimens from 1. Kelantan, Malaya, 63 mm., 2. Barrackpore, NE. India, 41 mm., 3. Sittang River, Burma, 44 mm., 4. Cauvery River, peninsular India, 37 mm., 5. Hazaribagh, NE. India, 33·5 mm., 6. Kambala Talao, Kathiawar Peninsula, western India, 50 mm., 7. Matungama, Ceylon, 58·5 mm. (The measurements in mm. denote the standard length of the specimens.)

Photo : E. G. Silas

Cyprinus laubuca Valenciennes, *Hist. Nat. Poiss.* **16**, p. 456 (1842).

Leuciscus laubuca Bleeker, *Verh. Bat. Genootsch* **25**, p. 138 (1853).

Perilampus fulvescens Blyth, *Journ. Asiatic Soc. Bengal*, p. 163 (1860). Type locality : Tennasserim, Burma ; Day, F., *Proc. Zool. Soc. London*, p. 559 (1869).

Laubuca guttatus Bleeker, *Atl. Ichthyol.*, p. 33 (1863).

Chela laubuca Günther, *Catal. Brit. Mus., Fish.* **7**, p. 335 (1868) ; Smith, *Bull. U.S. Nat. Mus.* **188**, p. 81 (1945) ; Deraniyagala, *Colour. Atlas Ceylon Vert.* **I**, *Fishes*, p. 25 (1952).

Perilampus laubuca Day, *Proc. Zool. Soc. London*, pp. 380, 614 (1869) ; *Journ. Asiatic Soc. Bengal* **41**(2), p. 20 (1872) ; Fish. India, p. 598, pl. cli, fig. 5 (1878) ; *Fauna Brit. India, Fish*, p. 360, fig. 112 (1889) ; Pillay, *JBNHS* **33**, p. 357 (1929) ; John, *JBNHS* **38**, p. 713 (1936).

Laubuca (*Laubuca*) *laubuca* Deraniyagala, *Spol. Zeylan.* **16**, p. 34 (1930).

Laubuca laubuca Shaw & Shebbeare, *Journ. Roy. Asiatic Soc. Bengal* **3**, p. 20, fig. 12, pl. ii, fig. 16 (1938) ; Das, *Rec. Indian Mus.* **41**, p. 439 fig. 1 (1939).

Laubuca siamensis Fowler, *Proc. Acad. Nat. Sci. Philadelphia* **91**, p. 64, fig. 14 (1939). Type locality: Waterfall stream near Trang, Thailand.

D.2/8-10 ; P. 1/8-11 ; V.1/6 ; A. 2/17-22 (19-24) ; C.19 ; L. 1.31-37 ; L. tr. 6-7/1/2½-4

The detailed morphometric analysis of this species (Tables I—VII), based on material examined from Ceylon, peninsular India, Kathiawar Peninsula, north-eastern India, Burma, Thailand, and the Malay Peninsula, is given mainly with a view to indicate the range of variations to be expected in the species and also draw attention to any correlations that exist between the geographical location of the species and these variations. The samples from Ceylon, Burma, and Malaya are limited but, when compared to the typical form from the Gangetic watershed (north-eastern India), they seem to evince certain peculiarities in character, which might be interpreted as being of at least subspecific significance. In this revision, these variations are indicated, with the hope that later investigators, with larger samples to work on, will find it much easier to proceed.

As Hamilton's type of *Cyprinus laubuca* came from the Gangetic watershed, the sample examined here from north-eastern India from this watershed is considered as being typical and comparisions are made with this (Plate I, figs. 2, 5). The standard length of the specimens examined from this area ranges from 19 to 52 mm.

1. *Malay Peninsula* :—The specimens examined from Malay Peninsula are comparatively larger in size, being 53 to 61 mm. in standard length (Plate I fig. 1). The dark mid-lateral stripe is present, being more conspicuous in the posterior part of the body ending at the base of the

caudal fin as a precaudal spot. The shoulder spot is markedly distinct. The mid-dorsal stripe is narrow and the supra anal streak is faintly visible in the preserved specimens. The reticulated markings on the sides of the body above the pectorals are present, though indistinct.

In addition to these, the Malayan form has a much deeper body, longer caudal fin, shorter head, a comparatively shorter dorsal fin, longer pectoral and pelvic fins, a less deep caudal peduncle, a relatively higher count in the lateral line and predorsal scales, and, finally, the origin of the pelvic fin is in a more anterior position than seen in specimens from north-eastern India. In the remaining characters, they more or less agree with the latter.

It is likely, the variations encountered in the Malayan specimens might eventually prove to be of even greater significance than mere subspecific variation. These specimens, although agreeing in general with the description of *Laubuca* (*Laubuca*) *laubuca* of Sumatra, as given by Weber & de Beaufort (1916), show variations in the following details : the anal fin rays are 22 *versus* 21 in the Sumatran forms ; lateral line scales 34 to 36 *versus* 32 to 34 ; scales between lateral line and pelvic fin 2½ to 4 *versus* 5 ; diameter of eye in head length 3.12 to 3.75 *versus* nearly 3 ; diameter of eye in interorbital distance 1.5 to 1.8 *versus* less than 1.0 ; and predorsal scales 18 to 21 *versus* 18 or 19. Some of these differences may be accounted for as being due to differences in the size of the specimens (Malayan specimens 67 to 84 mm. in total length and the Sumatran specimens slightly over 60 mm.) and on account of the smaller samples studied. The problem is worthy of a more detailed investigation.

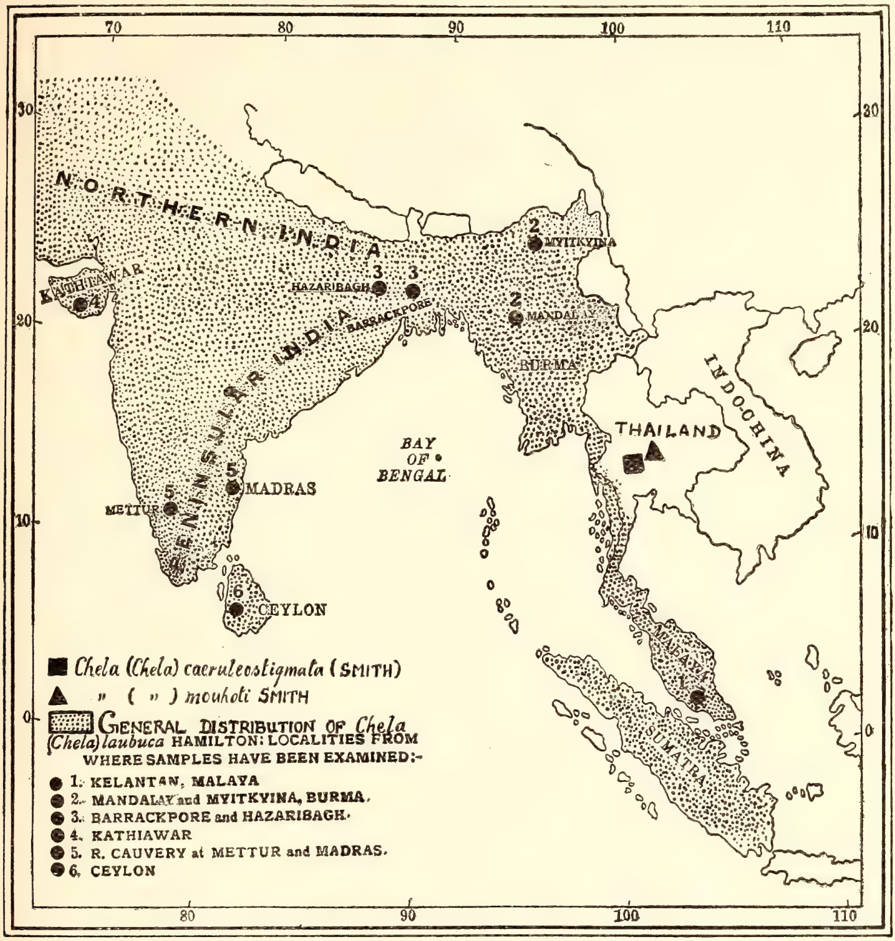
2. *Thailand*:—I had the opportunity of examining the type material of *Laubuca siamensis* Fowler while recently visiting the Academy of Natural Sciences, Philadelphia, and confirm the late Dr. H. M. Smith's view that *L. siamensis* is conspecific with *C. laubuca* Hamilton, for there seems to be no difference worthy of mention to separate it as a distinct species from the typical form.

3. *Burma*:—The specimens measure 27 to 55 mm. in standard length and as they have been in preservative over a long period much of the colour has been lost (Plate I fig. 3). The dark lateral stripe is faintly visible.

The body of the Burmese examples is much deeper and more compressed ; the dorsal and anal fins are relatively more posteriorly situated and have a higher predorsal count than in the typical form.

Perilampus fulvescens Blyth from Tennasserim, Burma, is very imperfectly characterised, and the description shows no difference from the characters of the Burmese examples both from the Irrawady and the Salween drainages presented here (Tables I-VII). As in the case of

L. siamensis Fowler from Thailand, I do not consider the minor differences noted in the Burmese specimens as being of sufficient importance to consider it a distinct species.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NORTHERN INDIA
KATHIAWAR
4
3
HAZARIBAGH
3
BARRACKPORE
PENINSULAR INDIA
2
MYITKYINA
2
MANDALAY
BURMA
THAILAND
INDOCHINA
BAY OF BENGAL
5
MADRAS
5
METTUR
6
CEYLON
MALAYA
1
SUMATRA
■ Chela (Chela) caeruleostigmata (SMITH)
▲ " (") mouhoti SMITH
▨ GENERAL DISTRIBUTION OF Chela (Chela) laubuca HAMILTON: LOCALITIES FROM WHERE SAMPLES HAVE BEEN EXAMINED:-
● 1. KELANTAN, MALAYA
● 2. MANDALAY and MYITKYINA, BURMA.
● 3. BARRACKPORE and HAZARIBAGH.
● 4. KATHIAWAR
● 5. R. CAUVERY at METTUR and MADRAS.
● 6. CEYLON
80
90
100
110

Text-figure 4.—Map showing the general distribution of *Chela* (*Chela*) *laubuca* Hamilton and the localities from where samples have been examined for the present study. The distribution of the Thailand species *caeruleostigmata* and *mouhoti* is also indicated.

4. *Kathiawar Peninsula, western India*:— Specimens measuring 26 to 50 mm. in standard length were collected by me from close to Porbandar (Plate I fig. 6). The coloration is as in those from NE. India; the dark lateral stripe being present in the form of a well-developed narrow stripe in the posterior three-fourths of the body; the shoulder spot well-developed; the precaudal spot more or less distinct in all the specimens; the mid-dorsal stripe less pronounced and the supra

TABLE I

Frequency distribution of the number of dorsal fin rays in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of fin rays			No. of specimens	Range	Average	Percentage		
	10	11	12				10	11	12
1. Malaya	—	6	—	6	11	11.00	—	100	—
2. Burma	—	8	—	8	11	11.00	—	100	—
3. NE. India	1	20	1	22	10-12	11.00	4.54	90.90	4.54
4. Kathiawar	1	34	1	36	10-12	11.00	2.77	94.44	2.77
5. Peninsular India ..	18	1	—	19	10-11	10.05	94.73	5.26	—
6. Ceylon	—	4	—	4	11	11.00	—	100	—
Total	20	73	2	95	10-12	10.80	21.05	76.84	2.10

TABLE II

Frequency distribution of the number of pectoral fin rays in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of fin rays				No. of specimens	Range	Average	Percentage	
	9	10	11	12				9-10	11-12
1. Malaya	—	—	2	4	6	11-12	11.66	—	100
2. Burma	—	—	1	7	8	11-12	11.87	—	100
3. NE. India	—	—	8	14	22	11-12	11.63	—	100
4. Kathiawar	1	6	19	10	36	9-12	11. 05	19.44	80.55
5. Peninsular India ..	—	—	6	12	18	11-12	11.66	—	100
6. Ceylon	—	—	3	1	4	11-12	11.25	—	100
Total	1	6	39	48	94	9-12	11.51	7.44	92.55

TABLE III

Frequency distribution of the number of anal fin rays in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of fin rays						No. of specimens	Range	Average	Percentage	
	19	20	21	22	23	24				19-21	22-24
1. Malaya	—	—	—	6	—	—	6	22	22.00	—	100
2. Burma	5	1	1	1	—	—	8	19-22	19.75	87.5	12.50
3. NE. India	1	2	4	7	6	3	23	19-24	22.04	30.43	69.56
4. Kathiawar	3	15	15	1	—	—	34	19-22	20-41	97.05	2.94
5. Peninsular India	—	—	5	6	8	—	19	21-23	22.57	26.31	73.68
6. Ceylon	1	—	—	2	1	—	4	19-23	21.50	25.00	75.00
Total	10	18	25	23	15	3	94	19-24	21.37	56.38	43.61

TABLE IV

Frequency distribution of the number of lateral line scales in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of Scales							No. of specimens	Range	Average	Percentage	
	31	32	33	34	35	36	37				31-34	35-37
1. Malaya ..	—	—	—	3	2	1	—	6	34-36	34.66	50.00	50.00
2. Burma ..	—	1	2	1	4	—	—	8	32-35	34.00	50.00	50.00
3. NE. India ..	1	2	6	7	4	—	—	20	31-35	33.65	80.00	20.00
4. Kathiawar ..	—	2	10	14	4	2	1	33	32-37	33.90	78.78	21.21
5. Peninsular India ..	—	3	5	2	5	—	—	15	32-35	33.60	66.66	33.33
6. Ceylon ..	—	—	1	1	1	1	—	4	33-36	34.50	50.00	50.00
Total ..	1	8	24	28	20	4	1	86	31-37	33.82	70.93	29.07

TABLE V

Frequency distribution of the number of predorsal scales in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of Scales							No. of specimens	Range	Average	Percentage		
	15	16	17	18	19	20	21				15-16	17-19	20-21
1. Malaya	—	—	—	3	2	—	1	6	18-21	18.83	—	83.33	16.66
2. Burma	—	—	2	4	—	1	—	7	17-20	18.00	—	85.71	14.29
3. NE. India ..	—	8	9	2	—	—	—	19	16-18	16.68	42.10	57.90	—
4. Kathiawar ..	3	15	15	1	—	—	—	34	15-17	16.41	52.94	47.05	—
5. Peninsular India ..	—	2	7	5	2	—	—	16	16-19	17.43	12.50	87.50	—
6. Ceylon	—	—	1	2	—	1	—	4	17-20	18.25	—	75.00	25.00
Total ..	3	25	34	17	4	2	1	86	15-21	16.97	32.55	63.95	3.48

TABLE VI

Frequency distribution of the number of scales between the lateral line and the pelvic fin in *Chela* (*Chela*) *laubuca* Hamilton

Locality	Number of scales			No. of specimens	Range	Average	Percentage		
	2½	3	4				2½	3	4
1. Malaya	1	3	1	5	2½-4	3.10	25.00	50.00	25.00
2. Burma	1	7	—	8	2½-3	2.93	12.50	87.50	—
3. NE. India	—	17	—	17	3	3.00	—	100.00	—
4. Kathiawar	—	30	5	35	3-4	3.28	—	85.71	14.28
5. Peninsular India ..	1	10	—	11	2½-3	2.95	9.09	90.90	—
6. Ceylon	2	2	—	4	2½-3	2.75	50.00	50.00	—
Total	5	69	6	80	2½-4	3.04	6.25	86.25	7.50

TABLE

Table giving the range of morphometric characters of the samples
(The number of specimens is given first, followed by the

Characters	Malaya	Burma	NE. India
Total length/Standard length ..	6 : 1.24–1.32 (1.30)	1 : 1.31 (1.31)	4 : 1.22–1.25 (1.23)
Total length/Length of head ..	6 : 5.53–5.84 (5.68)	1 : 5.11 (5.11)	4 : 4.83–5.00 (4.95)
Total length/Height of body ..	6 : 3.90–4.61 (4.10)	1 : 3.68 (3.68)	4 : 4.64–5.50 (4.91)
Total length/Width of body	6 : 9.22–12.16 (10.55)	1 : 11.50 (11.50)	4 : 9.66–10.00 (9.91)
Total length/Length of caudal fin ..	6 : 4.05–4.78 (4.29)	1 : 4.18 (4.18)	4 : 5.00–5.45 (5.29)
Standard length/Length of head ..	6 : 4.20–4.80 (4.35)	3 : 3.70–4.15 (3.91)	23 : 3.57–4.08 (3.82)
Standard length/Height of body ..	6 : 3.02–3.11 (3.14)	3 : 2.80–3.22 (2.95)	23 : 2.60–4.08 (3.29)
Standard length/Width of body	6 : 7.00–9.33 (8.09)	3 : 7.69-9.00 (8.48)	22 : 7.33–9.33 (7.99)
Standard length/Tip of snout to origin of dorsal fin	6 : 1.40–1.45 (1.43)	3 : 1.51–1.55 (1.53)	23 : 1.32–1.60 (1.49)
Standard length/Origin of dorsal to base of caudal fin	6 : 2.80–2.94 (2.86)	3 : 2.59–2.70 (2.64)	23 : 2.53–3.18 (2.82)
Standard length/Tip of snout to origin of anal fin	6 : 1.43–1.51 (1.47)	3 : 1.40–1.47 (1.44)	23 : 1.40–2.30 (1.59)
Standard length/Origin of anal to base of caudal..	6 : 2.52–2.70 (2.59)	3 : 2.38–2.84 (2.60)	23 : 2.25–3.06 (2.56)
Standard length/Tip of snout to origin of pelvic fin	5 : 2.20–2.65 (2.32)	3 : 2.05–2.17 (2.10)	23 : 2.05–2.35 (2.21)
Standard length/Origin of pelvic fin to base of caudal fin ..	5 : 1.39–1.56 (1.50)	3 : 1.38–1.68 (1.53)	23 : 1.56–1.80 (1.69)
Standard length/Length of caudal fin	6 : 3.06–3.78 (3.29)	1 : 3.18 (3.18)	4 : 4.00–4.45 (4.29)
Tip of snout to origin of dorsal fin/Origin of dorsal fin to base of caudal fin	6 : 1.95–2.05 (1.99)	3 : 1.66–1.75 (1.71)	23 : 1.68–2.19 (1.88)

VII

of *Chela* (*Chela*) *laubuca* examined, expressed here as ratios.
range, below which the mean is given in parenthesis)

Kathiawar	Peninsular India	Ceylon	Total No. of specimens	Total Range (Mean)
33 : 1.18–1.40 (1.29)	17 : 1.24–1.40 (1.31)	3 : 1.28–1.31 (1.29)	64	1.18–1.40 (1.29)
33 : 4.47–6.10 (5.37)	17 : 4.50–5.50 (4.99)	3 : 4.81–5.70 (5.30)	64	4.47–6.10 (5.27)
33 : 3.41–4.31 (3.81)	17 : 4.12–5.00 (4.50)	3 : 3.85–4.15 (4.02)	64	3.41–5.50 (4.10)
10 : 9.28–12.00 (10.92)	17 : 9.42–12.00 (10.66)	3 : 11.00–13.25 (12.08)	41	9.22–13.25 (10.75)
33 : 3.68–6.33 (4.44)	17 : 3.45–5.07 (4.24)	3 : 4.16–4.40 (4.35)	64	3.45–6.33 (4.17)
36 : 3.37–4.87 (4.14)	19 : 3.50–4.41 (3.38)	4 : 3.72–4.33 (4.14)	91	3.37–4.87 (4.00)
36 : 2.50–3.47 (2.95)	19 : 2.86–3.81 (3.38)	4 : 2.92–3.58 (3.22)	91	2.50–4.08 (3.15)
12 : 7.14–9.60 (8.50)	19 : 7.00–9.20 (8.19)	4 : 8.35–10.25 (9.13)	66	7.00–10.25 (8.24)
36 : 1.46–1.69 (1.55)	19 : 1.38–1.61 (1.48)	4 : 1.44–1.50 (1.48)	91	1.32–1.69 (1.51)
36 : 2.36–3.12 (2.67)	19 : 2.54–3.13 (2.79)	4 : 2.65–3.15 (2.82)	91	2.36–3.18 (2.75)
36 : 1.33–1.65 (1.45)	18 : 1.46–1.64 (1.54)	4 : 1.42–1.56 (1.48)	90	1.33–2.30 (1.57)
36 : 2.16–2.90 (2.56)	18 : 2.30–2.70 (2.47)	4 : 2.48–2.78 (2.58)	90	2.16–3.06 (2.54)
36 : 1.91–2.23 (2.05)	18 : 2.00–2.45 (2.25)	4 : 2.25–2.45 (2.36)	89	1.91–2.65 (2.14)
36 : 1.41–1.72 (1.55)	18 : 1.53–1.75 (1.61)	4 : 1.50–1.61 (1.57)	89	1.38–1.88 (1.59)
33 : 2.88–4.10 (3.42)	17 : 2.45–4.07 (3.24)	3 : 3.16–3.50 (3.35)	64	2.45–4.45 (3.41)
33 : 1.46–2.12 (1.86)	19 : 1.63–2.09 (1.87)	4 : 1.77–2.11 (1.91)	88	1.46–2.19 (1.87)

TABLE VII

Table giving the range of morphometric characters of the samples of *Chela* (*Chela*) *laubuca* examined, expressed here as ratios. (The number of specimens is given first, followed by the range, below which the mean is given in parenthesis)

Characters	Malaya	Burma	NE. India	Kathiawar	Peninsular India	Ceylon	Total No. of specimens	Total Range (Mean)
Total length/Standard length ..	6 : 1.24–1.32 (1.30)	1 : 1.31 (1.31)	4 : 1.22–1.25 (1.23)	33 : 1.18–1.40 (1.29)	17 : 1.24–1.40 (1.31)	3 : 1.28–1.31 (1.29)	64	1.18–1.40 (1.29)
Total length/Length of head ..	6 : 5.53–5.84 (5.68)	1 : 5.11 (5.11)	4 : 4.83–5.00 (4.95)	33 : 4.47–6.10 (5.37)	17 : 4.50–5.50 (4.99)	3 : 4.81–5.70 (5.30)	64	4.47–6.10 (5.27)
Total length/Height of body ..	6 : 3.90–4.61 (4.10)	1 : 3.68 (3.68)	4 : 4.64–5.50 (4.91)	33 : 3.41–4.31 (3.81)	17 : 4.12–5.00 (4.50)	3 : 3.85–4.15 (4.02)	64	3.41–5.50 (4.10)
Total length/Width of body	6 : 9.22–12.16 (10.55)	1 : 11.50 (11.50)	4 : 9.66–10.00 (9.91)	10 : 9.28–12.00 (10.92)	17 : 9.42–12.00 (10.66)	3 : 11.00–13.25 (12.08)	41	9.22–13.25 (10.75)
Total length/Length of caudal fin ..	6 : 4.05–4.78 (4.29)	1 : 4.18 (4.18)	4 : 5.00–5.45 (5.29)	33 : 3.68–6.33 (4.44)	17 : 3.45–5.07 (4.24)	3 : 4.16–4.40 (4.35)	64	3.45–6.33 (4.17)
Standard length/Length of head ..	6 : 4.20–4.80 (4.35)	3 : 3.70–4.15 (3.91)	23 : 3.57–4.08 (3.82)	36 : 3.37–4.87 (4.14)	19 : 3.50–4.41 (3.38)	4 : 3.72–4.33 (4.14)	91	3.37–4.87 (4.00)
Standard length/Height of body ..	6 : 3.02–3.11 (3.14)	3 : 2.80–3.22 (2.95)	23 : 2.60–4.08 (3.29)	36 : 2.50–3.47 (2.95)	19 : 2.86–3.81 (3.38)	4 : 2.92–3.58 (3.22)	91	2.50–4.08 (3.15)
Standard length/Width of body	6 : 7.00–9.33 (8.09)	3 : 7.69-9.00 (8.48)	22 : 7.33–9.33 (7.99)	12 : 7.14–9.60 (8.50)	19 : 7.00–9.20 (8.19)	4 : 8.35–10.25 (9.13)	66	7.00–10.25 (8.24)
Standard length/Tip of snout to origin of dorsal fin	6 : 1.40–1.45 (1.43)	3 : 1.51–1.55 (1.53)	23 : 1.32–1.60 (1.49)	36 : 1.46–1.69 (1.55)	19 : 1.38–1.61 (1.48)	4 : 1.44–1.50 (1.48)	91	1.32–1.69 (1.51)
Standard length/Origin of dorsal to base of caudal fin	6 : 2.80–2.94 (2.86)	3 : 2.59–2.70 (2.64)	23 : 2.53–3.18 (2.82)	36 : 2.36–3.12 (2.67)	19 : 2.54–3.13 (2.79)	4 : 2.65–3.15 (2.82)	91	2.36–3.18 (2.75)
Standard length/Tip of snout to origin of anal fin	6 : 1.43–1.51 (1.47)	3 : 1.40–1.47 (1.44)	23 : 1.40–2.30 (1.59)	36 : 1.33–1.65 (1.45)	18 : 1.46–1.64 (1.54)	4 : 1.42–1.56 (1.48)	90	1.33–2.30 (1.57)
Standard length/Origin of anal to base of caudal..	6 : 2.52–2.70 (2.59)	3 : 2.38–2.84 (2.60)	23 : 2.25–3.06 (2.56)	36 : 2.16–2.90 (2.56)	18 : 2.30–2.70 (2.47)	4 : 2.48–2.78 (2.58)	90	2.16–3.06 (2.54)
Standard length/Tip of snout to origin of pelvic fin	5 : 2.20–2.65 (2.32)	3 : 2.05–2.17 (2.10)	23 : 2.05–2.35 (2.21)	36 : 1.91–2.23 (2.05)	18 : 2.00–2.45 (2.25)	4 : 2.25–2.45 (2.36)	89	1.91–2.65 (2.14)
Standard length/Origin of pelvic fin to base of caudal fin ..	5 : 1.39–1.56 (1.50)	3 : 1.38–1.68 (1.53)	23 : 1.56–1.80 (1.69)	36 : 1.41–1.72 (1.55)	18 : 1.53–1.75 (1.61)	4 : 1.50–1.61 (1.57)	89	1.38–1.88 (1.59)
Standard length/Length of caudal fin	6 : 3.06–3.78 (3.29)	1 : 3.18 (3.18)	4 : 4.00–4.45 (4.29)	33 : 2.88–4.10 (3.42)	17 : 2.45–4.07 (3.24)	3 : 3.16–3.50 (3.35)	64	2.45–4.45 (3.41)
Tip of snout to origin of dorsal fin/Origin of dorsal fin to base of caudal fin	6 : 1.95–2.05 (1.99)	3 : 1.66–1.75 (1.71)	23 : 1.68–2.19 (1.88)	33 : 1.46–2.12 (1.86)	19 : 1.63–2.09 (1.87)	4 : 1.77–2.11 (1.91)	88	1.46–2.19 (1.87)

TABLE

Characters	Malaya	Burma	NE. India
Tip of snout to origin of dorsal fin/Origin of anal fin to base of caudal fin . .	6 : 1.68–1.83 (1.75)	3 : 1.61–1.94 (1.80)	23 : 1.31–1.94 (1.63)
Origin of pelvic fin to base of caudal fin/Tip of snout to origin of pelvic fin . .	5 : 1.44–1.69 (1.54)	3 : 1.23–1.56 (1.38)	23 : 1.21–1.43 (1.30)
Length of head/Width of head	6 : 1.64–2.14 (1.80)	3 : 1.80–1.85 (1.81)	19 : 1.77–2.33 (1.94)
Length of head/Height of occiput	6 : 1.40–1.64 (1.50)	3 : 1.50–1.58 (1.54)	19 : 1.33–1.87 (1.52)
Length of head/Length of snout	6 : 2.77–3.75 (3.25)	3 : 3.00–3.85 (3.36)	19 : 3.00–4.25 (3.50)
Length of head/Diameter of eye	6 : 3.12–3.75 (3.37)	3 : 3.00–3.85 (3.36)	19 : 3.00–4.00 (3.25)
Length of head/Interorbital distance	6 : 1.75–2.08 (1.90)	3 : 1.80–2.07 (1.95)	20 : 1.60–2.85 (1.96)
Interorbital distance/Diameter of eye . .	6 : 1.50–1.87 (1.77)	3 : 1.62–1.85 (1.71)	19 : 1.50–1.83 (1.70)
Length of snout/Diameter of eye	6 : 0.84–1.25 (1.05)	3 : 1.00 (1.00)	19 : 0.80–1.25 (0.93)
Height of body/Height of dorsal fin	5 : 1.50–1.79 (1.68)	2 : 1.56–1.58 (1.57)	12 : 1.00–2.00 (1.36)
Length of Pectoral fin/Length of head . .	6 : 1.60–1.66 (1.62)	2 : 1.55–1.61 (1.58)	14 : 1.33–1.55 (1.41)
Length of pelvic fin/Length of head	5 : 0.85–1.28 (1.08)	3 : 0.88–1.00 (0.93)	11 : 0.53–0.75 (0.70)
Length of head/Longest anal ray	6 : 0.89–1.20 (1.00)	3 : 1.11–1.35 (1.25)	8 : 1.20–1.50 (1.27)
Height of body/Length of head	6 : 1.20–1.40 (1.39)	3 : 1.14–1.46 (1.33)	23 : 0.90–1.42 (1.12)
Length of caudal peduncle/Least height of caudal peduncle	6 : 1.00–1.60 (1.24)	3 : 1.16–1.50 (1.27)	19 : 1.18–1.50 (1.31)

VII—*Continued*

Kathiawar	Peninsular India	Ceylon	Total No. of specimens	Total Range (Mean)
36 : 1.50–2.00 (1.76)	18 : 1.41–1.81 (1.60)	4 : 1.61–1.95 (1.74)	90	1.31–2.00 (1.69)
36 : 1.20–1.60 (1.32)	18 : 1.20–1.54 (1.40)	4 : 1.44–1.54 (1.50)	89	1.20–1.69 (1.36)
12 : 1.57–2.20 (1.81)	13 : 1.60–2.00 (1.76)	4 : 1.68–2.00 (1.87)	57	1.57–2.33 (1.84)
12 : 1.22–1.57 (1.40)	13 : 1.40–1.71 (1.60)	4 : 1.42–1.69 (1.51)	57	1.22–1.87 (1.51)
12 : 2.75–4.40 (3.64)	13 : 3.00–4.00 (3.53)	4 : 3.33–3.66 (3.42)	57	2.75–4.40 (3.50)
12 : 2.75–3.66 (3.18)	13 : 2.66–3.33 (3.25)	4 : 3.33–3.66 (3.42)	57	2.66–4.00 (3.27)
12 : 1.77—2.44 (2.06)	13 : 1.66—2.15 (1.90)	3 : 1.81—2.20 (1.98)	57	1.60—2.87 (1.99)
16 : 1.28–2.00 (1.62)	13 : 1.33–2.00 (1.72)	4 : 1.66–1.83 (1.72)	61	1.28–2.00 (1.69)
12 : 0.62–1.14 (0.89)	13 : 0.72–1.00 (0.94)	4 : 1.00 (1.00)	57	0.62–1.25 (0.95)
12 : 1.46–1.88 (1.69)	13 : 1.20–1.64 (1.39)	4 : 1.41–1.90 (1.69)	48	1.00–2.00 (1.52)
12 : 1.44–1.81 (1.56)	13 : 1.38–1.71 (1.54)	4 : 1.36–1.60 (1.52)	51	1.33–1.81 (1.52)
36 : 0.64–0.80 (0.78)	13 : 0.76—1.12 (0.95)	3 : 1.11–1.40 (1.25)	71	0.53–1.40 (0.84)
12 : 1.10–1.37 (1.21)	13 : 0.92–1.33 (1.01)	4 : 1.00–1.22 (1.09)	46	0.89–1.50 (1.13)
36 : 1.11–1.60 (1.39)	19 : 0.91–1.50 (1.12)	4 : 1.18–1.48 (1.29)	91	0.90–1.60 (1.26)
20 : 1.16–1.66 (1.30)	11 : 1.14–1.40 (1.29)	4 : 1.25–1.60 (1.42)	63	1.00–1.66 (1.30)

TABLE VII—*Continued*

Characters	Malaya	Burma	NE. India	Kathiawar	Peninsular India	Ceylon	Total No. of specimens	Total Range (Mean)
Tip of snout to origin of dorsal fin/Origin of anal fin to base of caudal fin . .	6 : 1.68—1.83 (1.75)	3 : 1.61—1.94 (1.80)	23 : 1.31—1.94 (1.63)	36 : 1.50—2.00 (1.76)	18 : 1.41—1.81 (1.60)	4 : 1.61—1.95 (1.74)	90	1.31—2.00 (1.69)
Origin of pelvic fin to base of caudal fin/Tip of snout to origin of pelvic fin . .	5 : 1.44—1.69 (1.54)	3 : 1.23—1.56 (1.38)	23 : 1.21—1.43 (1.30)	36 : 1.20—1.60 (1.32)	18 : 1.20—1.54 (1.40)	4 : 1.44—1.54 (1.50)	89	1.20—1.69 (1.36)
Length of head/Width of head	6 : 1.64—2.14 (1.80)	3 : 1.80—1.85 (1.81)	19 : 1.77—2.33 (1.94)	12 : 1.57—2.20 (1.81)	13 : 1.60—2.00 (1.76)	4 : 1.68—2.00 (1.87)	57	1.57—2.33 (1.84)
Length of head/Height of occiput	6 : 1.40—1.64 (1.50)	3 : 1.50—1.58 (1.54)	19 : 1.33—1.87 (1.52)	12 : 1.22—1.57 (1.40)	13 : 1.40—1.71 (1.60)	4 : 1.42—1.69 (1.51)	57	1.22—1.87 (1.51)
Length of head/Length of snout	6 : 2.77—3.75 (3.25)	3 : 3.00—3.85 (3.36)	19 : 3.00—4.25 (3.50)	12 : 2.75—4.40 (3.64)	13 : 3.00—4.00 (3.53)	4 : 3.33—3.66 (3.42)	57	2.75—4.40 (3.50)
Length of head/Diameter of eye	6 : 3.12—3.75 (3.37)	3 : 3.00—3.85 (3.36)	19 : 3.00—4.00 (3.25)	12 : 2.75—3.66 (3.18)	13 : 2.66—3.33 (3.25)	4 : 3.33—3.66 (3.42)	57	2.66—4.00 (3.27)
Length of head/Interorbital distance	6 : 1.75—2.08 (1.90)	3 : 1.80—2.07 (1.95)	20 : 1.60—2.85 (1.96)	12 : 1.77—2.44 (2.06)	13 : 1.66—2.15 (1.90)	3 : 1.81—2.20 (1.98)	57	1.60—2.87 (1.99)
Interorbital distance/Diameter of eye . .	6 : 1.50—1.87 (1.77)	3 : 1.62—1.85 (1.71)	19 : 1.50—1.83 (1.70)	16 : 1.28—2.00 (1.62)	13 : 1.33—2.00 (1.72)	4 : 1.66—1.83 (1.72)	61	1.28—2.00 (1.69)
Length of snout/Diameter of eye	6 : 0.84—1.25 (1.05)	3 : 1.00 (1.00)	19 : 0.80—1.25 (0.93)	12 : 0.62—1.14 (0.89)	13 : 0.72—1.00 (0.94)	4 : 1.00 (1.00)	57	0.62—1.25 (0.95)
Height of body/Height of dorsal fin	5 : 1.50—1.79 (1.68)	2 : 1.56—1.58 (1.57)	12 : 1.00—2.00 (1.36)	12 : 1.46—1.88 (1.69)	13 : 1.20—1.64 (1.39)	4 : 1.41—1.90 (1.69)	48	1.00—2.00 (1.52)
Length of Pectoral fin/Length of head . .	6 : 1.60—1.66 (1.62)	2 : 1.55—1.61 (1.58)	14 : 1.33—1.55 (1.41)	12 : 1.44—1.81 (1.56)	13 : 1.38—1.71 (1.54)	4 : 1.36—1.60 (1.52)	51	1.33—1.81 (1.52)
Length of pelvic fin/Length of head	5 : 0.85—1.28 (1.08)	3 : 0.88—1.00 (0.93)	11 : 0.53—0.75 (0.70)	36 : 0.64—0.80 (0.78)	13 : 0.76—1.12 (0.95)	3 : 1.11—1.40 (1.25)	71	0.53—1.40 (0.84)
Length of head/Longest anal ray	6 : 0.89—1.20 (1.00)	3 : 1.11—1.35 (1.25)	8 : 1.20—1.50 (1.27)	12 : 1.10—1.37 (1.21)	13 : 0.92—1.33 (1.01)	4 : 1.00—1.22 (1.09)	46	0.89—1.50 (1.13)
Height of body/Length of head	6 : 1.20—1.40 (1.39)	3 : 1.14—1.46 (1.33)	23 : 0.90—1.42 (1.12)	36 : 1.11—1.60 (1.39)	19 : 0.91—1.50 (1.12)	4 : 1.18—1.48 (1.29)	91	0.90—1.60 (1.26)
Length of caudal peduncle/Least height of caudal peduncle	6 : 1.00—1.60 (1.24)	3 : 1.16—1.50 (1.27)	19 : 1.18—1.50 (1.31)	20 : 1.16—1.66 (1.30)	11 : 1.14—1.40 (1.29)	4 : 1.25—1.60 (1.42)	63	1.00—1.66 (1.30)

anal streak and the subpeduncular stripe etc. absent. A few golden and steel-blue vertical markings are seen on the sides of the body during life. In formalin-preserved specimens they take the shape of a few grey broad vertical patches, more clearly discernible in the anterior half of the body. The fins are generally yellowish.

The specimens differ from those from NE. India in having a more compressed and slightly deeper body ; shorter head, more posteriorly situated pelvic fins, and a lower anal fin ray count, none of which appear to be significant enough to consider them as being specifically distinct.

5. *Peninsular India*:—(Plate I, fig. 4) The specimens that I have examined are from the Cauvery River and are mostly immature, ranging from 14 to 34 mm. in standard length. They have a relatively longer caudal fin, a more elongated body which is less deep, more anteriorly situated pelvic fin, and a lower dorsal fin ray count than in the typical form.

6. *Ceylon*:—(Plate I, fig. 7). The specimens examined from Ceylon range from 41 to 58.5 mm. in standard length. When compared to the typical forms, the Ceylon specimens have a relatively shorter head, a much deeper body, a longer caudal fin, more anteriorly situated pelvic fins which are much longer ; smaller eyes, a longer caudal peduncle, a more posteriorly situated anal fin, and a higher lateral line and predorsal scale count.

General Remarks:—Characters such as the length of the head, the origin of the pelvic fin and its length, the number of lateral line scales, predorsal scales, and transverse row of scales on the body and the dorsal and anal fin rays seem to be more dependable for a study of geographical variations in this species as variations in these characters are found to have some consistency and correlation with the geographical location of the species. Although the height of the body may depend on the size of the specimens, the relatively deeper body of the Malayan and Ceylonese specimens indicates something more than mere individual variation. This study points to the fact that like *cachius* the species *laubuca* is also polytypic.

Distribution:—Ceylon, India, Pakistan, Burma, peninsular Thailand, Malay Peninsula, and Sumatra.

Material Examined:—(*a*) *Malay Peninsula.* 5 specimens from River Kondar, Kelantan, Malay Peninsula (Unregistered collection at the Z.S.I. received from the Raffles Museum) ; 1 specimen from Kaki Bukti, Perlis, Malay Peninsula (Unregistered collection at the Z.S.I. received from the Raffles Museum). (*b*) *Thailand.* 3 specimens, being the type and 2 paratypes of *Laubuca siamensis* Fowler collected by the R.M.de Schauensee Siamese Expedition from a waterfall stream at Trang, Thailand, on 13 October 1936 (A.N.S.P. Cat. No. 68496 Type ; Cat. No. 68497-68498 Paratypes). (*c*) *Burma.* 1 specimen from Moulmein, Burma, from Day's collection (Z.S.I. Cat No. 906) ; 4 specimens from Sittang River, Burma, from Day's collection (Z.S.I. Cat. No. 908) ; 1 specimen from Mandalay, Burma, from Day's collection (Z.S.I. Cat. No. 913) ; and 2 specimens from the north end of Indawgyi Lake near Ngaungbin Village, Myitkyinea Dt., Upper Burma (Z.S.I. No. F. 10960/1). (*d*) *Kathiawar Peninsula, western India.* 26 specimens collected by me from Ranavikra and Sukala Talao, close to Porbandar; 10 specimens collected by me from Kambala Talaos, 23 miles off Porbandar; [2 specimens from Saidabad, Karachi Dt., Pakistan (B.N.H.S. No. 447-1) are very badly damaged]. (*e*) *Peninsular India.* 19 specimens from the Cauvery River at Hogaikanal Falls (Mettur Survey) opposite Dak Bungalow (Unregistered collection : Z.S.I.) ; (*f*) *Ceylon.* 1 specimen from Kallarouya, Cheddikulum, Ceylon ; 1 specimen from Matungama, Ceylon ; 2 specimens from Manampitiya, Ceylon—all received on loan from the Colombo Museum, Ceylon.

Vernacular Names:—Day (1872) mentions the following vernacular names for this species : *Layubuka* and *Dankena*, Bengali ; *Dannahrah*, Hindi ; *Bankoe*, Oriya ; and *Nga-me-loung*, Burmese.

Chela (Chela) caeruleostigmata (Smith)

(Text-Figure 2, *c*)

Laubuca caeruleostigmata Smith, *Proc. U.S. Nat. Mus.* **79**, p. 5, fig. 3 (1931). Type locality : Menam Chao river and its tributaries, central Thailand.
Chela caeruleostigmata Smith, *Bull. U.S. Nat. Mus.* **188**, p. 79, fig. 3 (1945).

D.2/11 ; P.1/10 ; V.1/5 ; A.2/22 ; C.19 ; L.1.34-35 ; L. tr. 8½-9/1/4½-5.

The head is contained about 5.2 in the total and 3.9. to 4.2 in the standard length. The height of the body is about 2.8 in the total and 2.05 to 2.25 in the standard length. The width of the body is contained about 7.16 in the standard length. The mouth is almost vertically directed upwards, the cleft not extending below the anterior margin of the eye. The height of the head at occiput is contained about 1.37, width of head about 1.57, and length of snout about 3.14 in the length of the head. The diameter of the eye is contained 3.5 to 3.66 in the head length, 1.5 to 2.16 in the interorbital distance, and about 1.17 in the length of the snout. The interorbital distance is about 1.7 times contained in the length of the head, while the latter is about 1.91 times contained in the height of the body. The caudal peduncle is much deeper than long, its least height being 0.58 of its length and contained about 1.83 to 2.0 times in the length of the head.

The distance from the tip of the snout to the origin of the dorsal fin is contained 1.53, origin of the dorsal fin to base of the caudal fin about 2.7, tip of snout to origin of the anal fin about 1.4, origin of the anal fin to base of caudal fin about 2.32, tip of snout to origin of pelvic fin about 1.79, and distance from origin of pelvic fin to base of caudal fin about 1.48 in the standard length. The distance from the tip of the snout to the origin of the dorsal fin is 1.75 times the distance from the origin of the dorsal fin to the base of the caudal fin ; tip of snout to the origin of the anal fin about 1.67 times that of the distance from the origin of the anal fin to the base of the caudal fin, and the origin of the pelvic fin to the base of the caudal fin is about 1.2 times the distance from the tip of the snout to the origin of the pelvic fin.

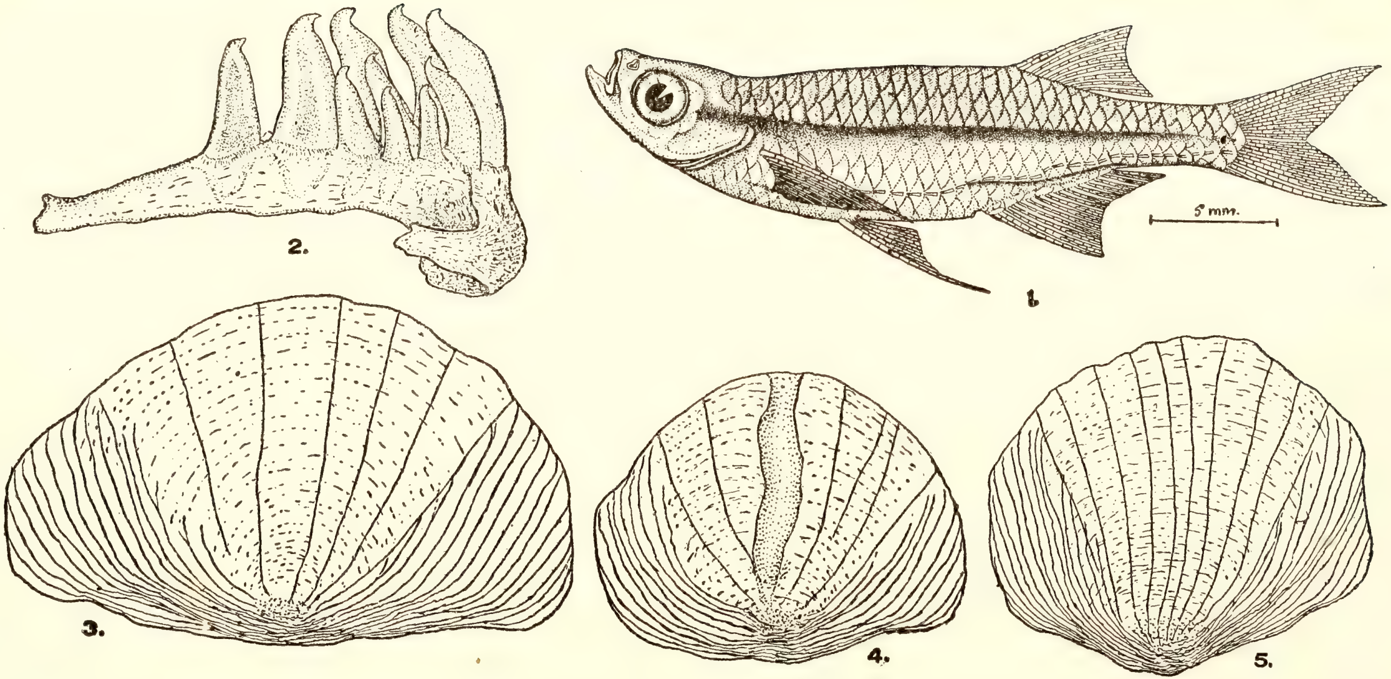
The height of the dorsal fin is contained about 1.29 in the length of the head and about 2.47 in the greatest height of the body. Pectoral fin is 1.75 to 2.0 times longer than the head. The pelvic fin is more than half the length of the pectoral fin and its outer ray is filamentous and about 1.04 times the length of the head. The length of the longest anal ray is contained about 1.29 to 1.5 times in the head length. The caudal fin is longer than the head and is deeply forked.

The lateral line scales number 34 to 35 and there are 17 to 19 predorsal scales. The scales round the narrowest part of the caudal peduncle number 12 or 13 rows. At least 4½ or 5 rows of scales are present between the lateral line and the origin of the pelvic fin in an oblique series, and about 8 to 9 rows between the lateral line and the point of origin of the dorsal fin. Anteriorly, the keeled abdominal surface extends to almost a vertical below the anterior origin of the pectoral fin.

The characteristic coloration of this species is given in the synopsis to the species on page 65.

Distribution: Menam Chao River and its tributaries, central Thailand.

Material examined: In August 1956, I had occasion to examine the type and paratypes of this species in the collection of the U.S. National Museum, Washington D.C. Besides these, one paratype (Z.S.I. No. F. 11163/1) from Menam Chao Phye, below Nakon Sawan, central Thailand, has been examined for drawing up the above redescription.



Chela (*Allochela*) *fasciata* subgen. et sp. nov.

1. Lateral view of the Holotype 25 mm. in standard length ; 2. Pharyngeal bone and its teeth from a paratype. × 23½ ; 3. scale from side of body from above and ahead of pelvic fin × 40 ; 4. Scale from lateral line in front of pelvic fin × 40 ; 5. Scale from side of caudal peduncle above lateral line. × 40.

Chela (Chela) mouhoti Smith

(Text-Figure 2, *d*)

Chela mouhoti Smith, *Bull. U.S. Nat. Mus.* **188**, p. 81, fig. 4 (1945). Type locality: Pasak River at Pechabun, central Thailand.

A brief diagnosis of this species after Smith (1945) is given below to facilitate reference :

D. 3/10 ; A.3/23 ; L.1.31 ; L.tr. 7/1/5-6

Head 5.3 in total (from figure) and about 4.0 in standard length. Height of body 3.2 in total (from figure) and 2.25 in standard length. Mouth oblique, cleft extending to vertical below anterior margin of eye. Diameter of eye 3.0 in head length, 1.0 in interorbital width and slightly more than length of snout. Predorsal scales 20, and scales round caudal peduncle 14. Dorsal shorter than length of head, pectoral 1.75 times longer than head and equalling height of body, and pelvics more than half the length of head. Longest anal ray equals height of dorsal fin. Caudal deeply forked. Height of caudal peduncle at its narrowest part equals its length and is also equal to half the head length. In addition to the well-developed shoulder spot, the species has ' a faint median dark stripe on back from head half way to dorsal fin (predorsal stripe) ; back at base of dorsal and on upper part of caudal peduncle dark, dorsal and pectoral with blackish dots distally, caudal lobes dusky'.

Distribution: Pasak River at Pechabun, central Thailand. The species is known from only the type specimen at present in the collection of the U.S.National Museum (U.S.N.M. No. 107959) which I had occasion to examine in August 1956.

Subgenus ALLOCHELA *nov.*

The diagnostic characters of the subgenus are given on page 64. A description of the subgenotype is given below.

Subgenotype :—Chela (*Allochela*) *fasciata* sp. nov.

Chela (Allochela) fasciata *sp. nov.*[1]

(Pate II, figs. 1–5)

D. 2/7 ; P. 1/9 (1/8-9); V. 1/6 (1/5-6) ; A. 3/15 (3/14-15) ;
C. 19 ; L. 1.34 (33-34) ; L. tr. 6/1/1½ (1-1½)

Chela (*Allochela*) *fasciata* is a small species in which the body is slightly elongate and the head is slightly turned upwards. The dorsal profile is almost straight from the occiput to the origin of the dorsal fin from whence it slopes down gently to the base of the caudal fin. The ventral profile is slightly arched. The length of the head is contained 5.16 in the total and 4.16 (3.83-4.16) in the standard length. The width of the head is contained 1.71 (1.71-1.92), and the height of the head at occiput 1.5 (1.5-1.71) in its length. The snout is very short, its length being contained 6.0 times (5.2-6.0) in the length of the head. The mouth is small and is obliquely directed upwards. The cleft of the mouth does not extend to below the anterior margin of the orbit. The eyes are large and are situated more in the anterior half of the head. The diameter of the eye is contained 3.0 (3.0-3.37) in the head length and 1.37 (1.37-1.5)

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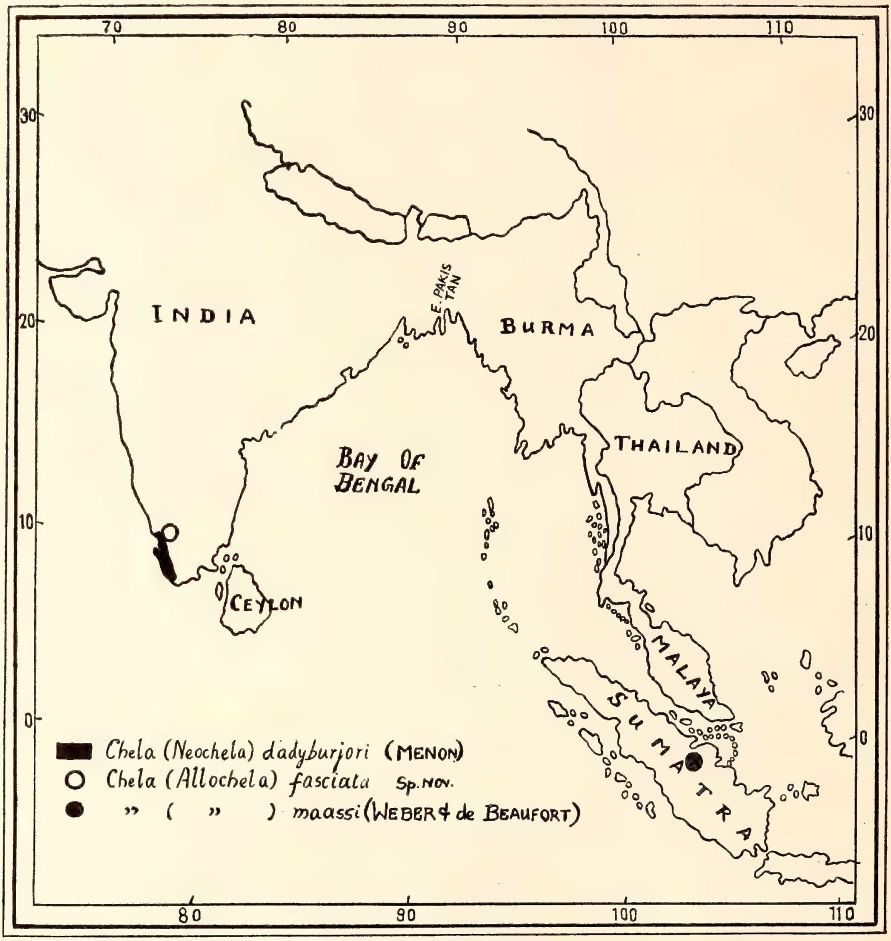
[1] In the description of the new species, the scales, the number of fin rays, and measurements of the Holotype measuring 25 mm. in standard length is given. This is followed in parenthesis by the range of variations, if any, shown by all the specimens (Holotype plus the 2 Paratypes).


70
80
90
100
110
30
20
10
0
INDIA
E. PAKISTAN
BURMA
THAILAND
BAY OF BENGAL
CEYLON
MALAYA
SUMATRA
■ Chela (Neochela) dadyburjori (MENON)
○ Chela (Allochela) fasciata Sp. nov.
● " (") maassi (WEBER & de BEAUFORT)

Text-figure 5.—Map showing the distribution of *Chela* (*Allochela*) *fasciata* sp. nov., *Chela* (*Allochela*) *maassi*, and *Chela* (*Neochela*) *dadyburjori*.

in the interorbital width. It is 0.5 (0.5-0.62) times the length of the snout. The interorbital space is almost flattened.

The greatest height of the body equals almost the length of the head and is 5.16 in the total and 4.16 (3.83-4.33) in the standard length. The width of the body is contained about 2.0 times in its height. The caudal peduncle is narrower and its least height is contained 1.77 (1.6-2.0) in its length and 2.66 (2.66-3.0) in the length of the head.

The dorsal fin is situated in the posterior third of the body (without the caudal fin) and its origin is opposite the second branched ray of the anal fin. The height of the dorsal fin is equal to or slightly shorter than the greatest height of the body, it being contained 1.2 (1.0-1.2) in the latter. The last undivided dorsal ray is weak, non-osseous, and articulated. The pectorals are long, being 1.33 (1.33-1.38) times longer than the head. They extend considerably beyond the commencement of the pelvic fins. The pelvic fin is longer than the head, its length being at least 1.16 times that of the latter. The outer pelvic ray is greatly elongated and when adpressed extends beyond the commencement of the anal fin. The anal fin is moderately elongated and its outer margin is slightly concave. The third to the eighth anterior anal rays are longer than the rest and the longest ray equals the height of the dorsal fin, but is slightly less than the head length. The caudal fin is forked and the lobes are pointed and of equal length. The length of the caudal fin is contained 5.16 in the total and 4.16 in the standard length.

The distance from the tip of the snout to the origin of the dorsal fin is 1.94 (1.87-1.94) times longer than the distance between the origin of the dorsal fin and the base of the caudal fin.

The scales are moderately large, well developed, and are longer in the dorso-ventral axis than in the cephalo-caudal axis. The lateral line is complete and strongly curved down from above the pectoral fin. The lateral line scales number 34 (33-34). There are also 34 (33-34) scales in a longitudinal series from the upper angle of the gill-opening to the middle of the base of the caudal fin. 6 rows of scales are present above the lateral line to the mid-dorsal row (exclusive), and 1½ (1-1½) rows between the lateral line and the base of the pelvic fin. The predorsal scales number 18. There are 9 (9–10) rows of scales round the narrowest part of the caudal peduncle. A sheath-like row of scales are present along the base of the anal fin. Three scales, one from the side of the body (Plate II, fig. 3), a second from the lateral line (Plate II, fig. 4), and a third from the side of the caudal peduncle (Plate II, fig. 5), are figured here from among several others examined to note their structural variations. Fundamentally all agree in being devoid of basal and lateral radii, and the circuli in the apical part of the scales are indistinct or ‘ degenerate ’. The nucleus is basal in position. A progressive increase in the number of apical radii and basal and lateral circuli is to be seen in the scales from the anterior part of the body.

TABLE VIII

Table giving the range, average, etc. of body proportions and scale counts of *Chela (Allochela) fasciata* sp. nov., the former expressed as ratios.

Characters	*No.*	*Holotype*	*Range*	*Average*
1. Total length/length of head.	1	5.16	5.16	5.16
2. Total length/length of caudal fin.	1	5.16	5.16	5.16
3. Total length/height of body	1	5.16	5.16	5.16
4. Standard length/length of head.	3	4.16	3.83—4.16	3.95
5. Standard length/length of caudal fin.	1	4.16	4.16	4.16
6. Standard length/height of body.	3	4.16	3.83—4.33	4.16
7. Length of head/width of head.	3	1.71	1.71—1.92	1.82
8. Length of head/height at occiput.	3	1.50	1.50—1.71	1.63
9. Length of head/length of snout.	3	6.00	5.20—6.00	5.73
10. Length of head/diameter of eye.	3	3.00	3.00—3.37	3.12
11. Length of snout/diameter of eye.	3	0.50	0.50—0.62	0.54
12. Interorbital distance/diameter of eye.	3	1.37	1.37—1.50	1.41
13. Height of body/width of body.	3	0.50	0.50	0.50
14. Length of caudal peduncle/its least height.	3	1.77	1.60—2.00	1.79
15. Height of body/height of dorsal fin.	3	1.20	1.09—1.20	1.16
16. Length of head/length of pectoral fin.	3	1.33	1.33—1.38	1.34
17. Length of head/length of pelvic fin.	2	1.16	1.16	1.16
18. Tip of snout to origin of dorsal/origin of dorsal to base of caudal fin.	3	1.94	1.87—1.94	1.89
19. Tip of snout to origin of anal/origin of anal to base of caudal fin.	3	1.60	1.57—1.60	1.58
20. Origin of pelvic fin to base of caudal fin/tip of snout to origin of pelvic fin.	3	1.40	1.40—1.55	1.47
21. Standard length/tip of snout to origin of dorsal fin.	3	1.51	1.51—1.53	1.52
22. Standard length/origin of dorsal fin to base of caudal fin.	3	2.94	2.77—2.94	2.86
23. Standard length/tip of snout to origin of anal fin.	3	1.56	1.53—1.57	1.55
24. Standard length/origin of anal fin to base of caudal fin.	3	2.50	2.42—2.50	2.46
25. Standard length/tip of snout to origin of pelvic fin.	3	2.27	2.26—2.30	2.27
26. Standard length/origin of pelvic fin to base of caudal fin	3	1.61	1.48—1.61	1.54
27. Number of lateral line scales.	3	33	33—34	33.33

The pharyngeal bone is about 5 times as wide as long. Its anterior edentulous process is fairly long and the pitted surface is narrow. The teeth are compressed and hooked and are placed in three rows, the formula being, 5.3.2.—2.3.5.

The coloration of the species is very characteristic. The upper half of the body is greyish and the scales on the upper half of the body have dark edges. The dark lateral stripe is broad, commences just behind the eye and runs along the middle of the body to almost the base of the caudal fin. A very well defined black supra-anal streak is present ; and so also the subpeduncular stripe. The mid-dorsal stripe running from the occiput to the origin of the dorsal fin is about one scale broad at its commencement. The fins are dirty white in colour. The margins of the upper and lower jaws are pigmented dark. The lower half of the body and the abdomen are lighter in colour.

Type specimens :—The Holotype 25 mm. in standard length (Z.S.I. No. 744/2) and the paratypes 23 and 26 mm. in standard length (Z.S.I. No. 745/2) have been deposited in the collection of the Zoological Survey of India, Calcutta.

Type locality :—Annamalai River at the base of the Annamalai Hills at a place called Vannathurai in Chittur Taluk, Malabar, peninsular India.

Chela (Allochela) maassi (Weber & de Beaufort)

(Text-figure 2, *e*)

Eustira maassi, Weber and de Beaufort, *In Maass* : ' *Durch Zentral Sumatra, Bd.* **2**, *Fishe*, p.531 (1912). Type locality : Gunung Sahilan on river Kamper, Sumatra.

Laubuca (*Eustira*) *maassi* Weber & de Beaufort, *Fish. Indo-Austral. Archipel.* **3**, p. 49, fig. 21 (1916).

A brief diagnosis of this species after Weber & de Beaufort (1916) is given below to facilitate reference :

D.2/7 ; A.3/10 ; P.1/11 ; V.1/6 ; L.1.34 ; L. tr. 6½/1/1-2

Head about 5.6 in total length (in figure) and 3.75 (about 4.1 in figure) in standard length. Height of body about 5.0 in total (in figure) and 3.3 in standard length. Diameter of eye contained 3.5 in head length, slightly more than one diameter of interorbital space and 1.3 times longer than snout. Mouth oblique, cleft reaching to about vertical below anterior margin of orbit. Predorsal scales number 20. Height of dorsal more than length of head ; longest anal ray equals half height of body ; pectorals 1.3 times longer than head, extending beyond pelvic origin ; pelvic fins half as long as height of body. Caudal fin long, more than

0.25 in total length. Least height of caudal peduncle contained about 2.0 times (in figure) in its length.

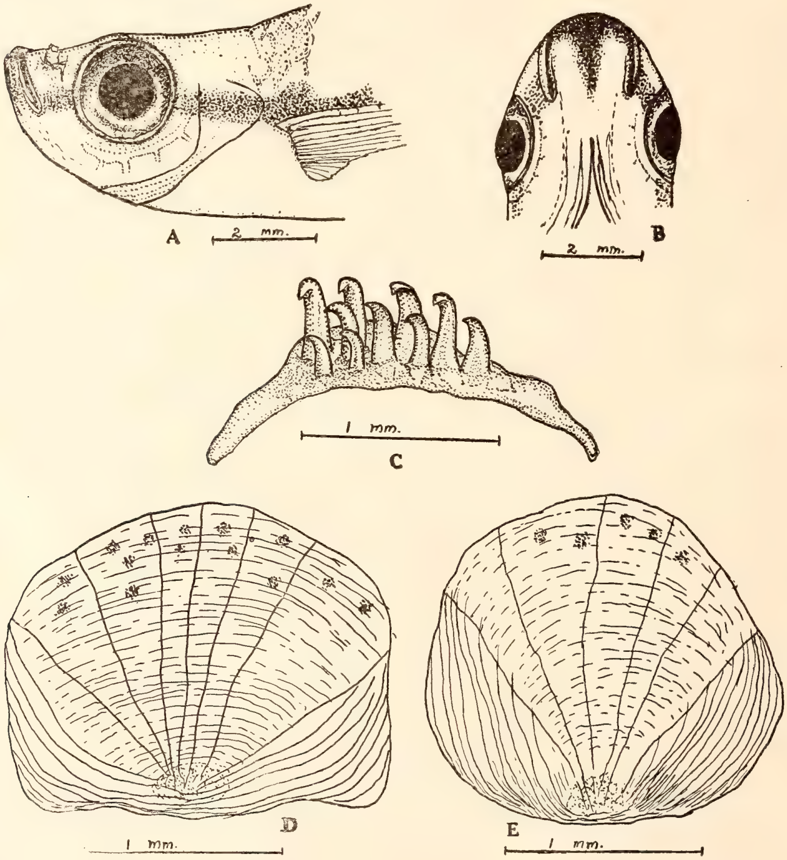
The colour of the species is said to be ' brown, back darker, a dark longitudinal band running from operculum to middle of base of caudal (dark lateral stripe), where it ends in a dark patch (precaudal spot). Fins hyaline. A dark median band along the back (middorsal stripe).'

Distribution:—Gunung Sahilan on river Kampar, Sumatra.

Subgenus NEOCHELA *nov.*

A diagnosis of this new subgenus is given on page 64.

Subgenotype:—*Laubuca dadidurjori* Menon [= *Chela* (*Neochela*) *dadyburjori* (Menon)].



Text-figure 6.—*Chela* (*Neochela*) *dadyburjori* (Menon). 1. Lateral view of head ; 2. Ventral view of anterior part of head; 3. Pharyngeal bone and the teeth arranged in three rows ; 4. Scale from side of body in front of dorsal origin ; 5. Scale from side of caudal peduncle.

Chela (Neochela) dadyburjori[1] (Menon)

(Text figure 2, *b* and 6, A-E.)

Laubuca dadidurjori Menon, *Rec. Indian Mus.* **49**, pp. 1-4 (1952). Type locality : Cochin, India.

Laubuca dadyburjori Dadyburjor, *Bull. Bombay Aquar. Soc.* **3**, (Nos. 1-2), pp. 12-13 (1955).

The type specimens of this species were not traceable in the fish collection of the Zoological Survey of India when required by me for reference early in 1955. However, I have recently received a small sample of this species from Trivandrum, Kerala State. In view of the several discrepancies and inaccuracies in the description of the type material and the table of measurements given for the same (Menon, 1952), a detailed analysis based on the present sample is given below :

D.2/7 ; A.3/11-12 ; P.1/7-9+2-3 ; V.1/5 ; C.17-18 ; L. tr. 7-8

In the accompanying tables the ratios of body proportions and the frequency distribution of the number of fin rays and scales are given. Clarifications on a few points which appear misleading in the descriptions of the types (Menon, *op. cit.*) are given below :

1. The eyes are situated more in the anterior half of the head and not ' entirely in the anterior half of the head '.

2. The first two rays of the dorsal fin and the first three rays of the anal fin are soft rays which are non-osseous, undivided, and the longest of these in each fin is articulated towards its tip and not ' The dorsal fin . . . . contains 2 spines and 7 branched rays . . . . the anal fin . . . . contains 3 spines and 11 branched rays '. In fact, ' spines ' are alien to fishes of the genus *Chela*.

3. The lateral line is absent in five of the ten specimens and when present it is seen as 2, 3, or 4 perforated scales just below the pectoral fin, near its base.

4. That ' The body is greatly compressed from side to side with a sharply cutting abdominal edge ' as given in the description of the types does not appear to be correct. In *dadyburjori*, the body is not greatly compressed as in species of *Chela* s. str., but is as in *Rasbora*, and the keeled nature of the abdomen is only very faintly indicated from the posterior third of the abdomen to the vent.

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[1] Three different spellings have been used to denote the species, namely *dadidurjori* and *dadiburjori* by Menon and *dadyburjori* by Sam Dadyburjor. The correct rendition of the species name appears to be that given by Dadyburjor and this amended spelling (*dadyburjori*) is used here.

5. The pectoral fin has got 2 or 3 minute, short, undivided rays at the inner (lower) angle of its base, in addition to the first undivided and 7 to 9 branched rays.

6. The caudal fin is subequal, the lower lobe being slightly the longer.

Other additional characters are as follows :

The branchiostegels are three in number. The pharyngeal teeth are triserial, the formula being 5-3-2/2-3-5 (Text-figure 6, C). The teeth are uncinate. The air-bladder is bipartate, the posterior chamber being the longer as is typical of the Cyprinidae.

The caudal fin has 15 or 16 branched rays. The pelvic fin does not extend beyond the origin of the anal fin and in a few examples reaches only up to the vent. The scales, one from the side of the body above the pectoral fin (Text-figure 6, D) and another from the side of the caudal peduncle (Text-figure 6, E), are figured here showing the details. There are nine rows of scales round the narrowest part of the caudal peduncle.

The colour of the species is very characteristic. When the specimens preserved in about 7% formalin were received from Trivandrum, some of the original colour markings were still present. In the larger examples the sides of the body above and near the base of the pectoral fins were tinged lemon-yellow with the dark pigment spots on the scales showing clearly. The dorsal and caudal fins were also tinged lemon-yellow with transparent margins, while the anal fin was light orange tipped with grey. The pectoral and pelvic fins were colourless except for the dark minute pigment spots on the outer rays of the pectorals. Within a week of receiving the specimens, most of these colour markings had disappeared. As regards the basic colour pattern, the dark mid-lateral stripe extends anteriorly to the posterior margin of the orbit and is continued again from the anterior margin of the orbit to the angle of the mouth (Text-figure 6, A). The margin of the lips is pigmented black and on the lower jaw from the symphysis running backwards to about a line between the angles of the mouth is a conical patch of black pigment spots (Text-figure 6, B). The posterior border of the scales on the back in front of the dorsal fin is bordered by a row of black pigment spots and the scales in the upper half of the body are minutely pigmented to give the appearance of a greyish tinge to the upper half of the body. The abdomen is whitish, with a few black pigment spots distributed along the sides. The vent in all the specimens is surrounded by a row of prominent pigment spots.

The dark mid-lateral stripe has on it 2 to 5 black circular spots from below the dorsal to the angle of the gill-opening more or less evenly spaced. The mid-dorsal stripe is more pronounced in the predorsal region than posteriorly. The subpeduncular and the supra anal streaks are present.

Distribution:—In streams, tanks, and pools in Cochin and Trivandrum, Kerala State, peninsular India.

Material examined:—10 specimens ranging from 15.5 to 21 mm. in standard length (19 to 28 mm. in total length) collected from small pools near the aerodrome, Trivandrum, by Mr. C. T. Samuel on 5-1-1958. (B.N.H.S.No. F.1/1).

Remarks:—The collection of this species from Trivandrum extends its distribution by well over a hundred miles to the south from Cochin, the type locality.

TABLE IX

Table showing the range, average, etc. of body proportions in *Chela* (*Neochela*) *dadyburjori*, expressed as ratios.

Characters	*No. of specimens*	*Range*	*Average*
1. Total length/standard length	10	1.21—1.35	1.27
2. Total length/length of head	10	4·44—5.60	4.90
3. Total length/height of body	10	5.33—6.33	5.75
4. Total length/width of body	10	8.80—11.20	10.95
5. Total length/length of caudal fin	10	3.81—5.57	4.67
6. Standard length/length of head	10	3.44—4.20	3.84
7. Standard length/height of body	10	4.00—5.16	4.50
8. Standard length/width of body	10	6.80—8.62	7.90
9. Standard length/tip of snout to origin of dorsal fin	10	1.48—1.68	1·55
10. Standard length/origin of dorsal to base of caudal fin	10	2.50—3.00	2.78
11. Standard length/tip of snout to origin of anal fin	10	1.50—1.68	1.61
12. Standard length/origin of anal to base of caudal fin	10	2.41—2.83	2.62
13. Standard length/tip of snout to origin of pelvic fin	10	2.06—2.30	2.15
14. Standard length/origin of pelvic to base of caudal fin	10	1.77—1.93	1.83
15. Standard length/length of caudal fin	10	2.81—4.57	3.72
16. Tip of snout to origin of dorsal/origin of dorsal to base of caudal fin	10	1.58—1.90	1.77
17. Tip of snout to origin of anal/origin of anal to base of caudal fin	10	1.46—1.75	1.62
18. Origin of pelvic to base of caudal/ tip of snout to origin of pelvic fin	10	1.06—1.28	1.16
19. Length of caudal peduncle/least height of caudal peduncle	10	1.62—2.40	2.02
20. Length of head/width of head	10	1.60—2.11	1.81
21. Height of body/length of head	10	0.75—1.05	0.85
22. Length of head/height at occiput	10	1.53—2.00	1.74
23. Length of head/longest anal ray	10	1.20—1.80	1.34
24. Length of head/length of snout	10	3.33—5.73	4.32
25. Length of pelvic fin/length of head	10	0.34—0.70	0.48
26. Length of head/diameter of eye	10	2.50—3.21	2.93
27. Length of pectoral/length of head	10	1.15—1.70	1.30
28. Length of head/interorbital distance	10	1.73—2.28	2.05
29. Height of body/height of dorsal fin	10	1.00—1.53	1.26
30. Interorbital distance/diameter of eye	10	1.25—1.73	1.43
31. Length of snout/diameter of eye	10	0.53—0.86	0.68

TABLE X

Frequency distribution of the number of fin rays and scales in *Chela* (*Neochela*) *dadyburjori* based on a sample from Trivandrum, Kerala State

(N = Number of specimens ; R = Range ; M = Mean)

	Pectoral fin rays[1]					Anal fin rays		Caudal fin rays	
Fin rays ..	1/7+2 (=10)	1/8+2 (=11)	1/8+3 (=12)	1/9+2 (=12)	1/9+3 (=13)	3/11 (=14)	3/12 (=15)	1+15+1 (=17)	1+16+1 (=18)
No. of specimens ..	1	2	7	8	2	6	4	7	3
Percentage ..	5%	10%	35%	40%	10%	60%	40%	70%	30%
	N = 20 fins ; R = 10–13 ; M = 11.9					N = 10 ; R = 14–15 ; M = 14.4		N = 10 ; R = 17–18; M = 17.3	

[1] This includes the fin-ray counts of both the pectoral fins (left and right) in each specimen.

	Predorsal scales			Scales between origin of dorsal and anal fins			Scales from mid-dorsal row (exclusive) to origin of pelvic fin			
No. of scales ..	17	18	19	6	7	8	6	7	8	9
No. of specimens ..	1	5	4	1	8	1	—	3	7	—
Percentage ..	10%	50%	40%	10%	80%	10%	—	30%	70%	—
	N = 10 ; R=17–19 ; M = 18.3			N = 10 ; R = 6–8 ; M = 7			N = 10 ; R = 7–8 ; M = 7.7			

Lateral linear scales

No. of scales	30	31	32	33	34	35	36
No. of specimens	—	—	1	3	4	2	—
Percentage	—	—	10%	30%	40%	20%	—

N = 10 ; R = 32–35 ; M = 33.7

ECONOMIC IMPORTANCE

1. *As larvicidal fishes:* The larvicidal propensity of *Chela* (=*Laubuca*) was commented on by Chaudhuri (1911), Southwell (1920), and Hora and Mukerji (1938). Although not comparable to the Cyprinodonts in this respect, *Chela* may be considered as a useful substitute and is of fair quality for larvicidal work. The two Indian species, *laubuca* and *cachius*, breed freely in ponds, tanks, and small streams, and in these habitats whenever they occur they are found in large numbers. Their easy availability on account of their wide distribution stands in their favour of being used as larvicidal fish.

2. *As aquarium fishes:* Ichthyological literature is studded with numerous instances of new species, especially from among the smaller carps, minnows, and loaches having been brought to light through the help of aquarium hobbyists. The dainty little species, *Chela* (*Neochela*) *dadyburjori*, is one such instance. The small size, colour, and hardiness of some of the species of *Chela* are the main reasons why they have found a place in the list of desirable tropical aquarium fishes. In India, the species *laubuca*, *cachius*, and *dadyburjori* are reared as aquarium fishes.

3. *Other uses:* The species *laubuca* and *cachius* are in many places used as bait for Mahseer, *Channa*, and other larger carnivorous fish. In many parts of the country villagers take these two species of *Chela* in large numbers along with species of *Rasbora*, *Oxygaster*, etc. and, when cooked or fried in numbers, they make a palatable dish. It is also likely that they may turn out to be good forage fishes.

DISCUSSION

The diversity in characters exhibited by the species has made it necessary to group them as given here (p. 63). Taking the species of *Chela* s. str., we find that two of them, namely *cachius* and *laubuca*, have a very wide distribution and evidence is adduced here to show that they are highly polytypic. The two central Thailand species of the *laubuca*-group, namely, *caeruleostigmata* and *mouhoti*, evince considerable affinities to *laubuca* which also occurs in peninsular Thailand. The two species of the subgenus *Allochela*, are discontinuously distributed, *fasciata* occurring in peninsular India and *maassi* known only from Sumatra. In the absence of a lateral line or only the presence of an incomplete lateral line *dadyburjori* occupies a peculiar position in the hierarchy of the genus.

As regards the distribution, one other interesting point to note is the absence of the widely distributed *cachius* from Ceylon. This revision should facilitate further detailed study of the species, especially *cachius* and *laubuca*, throughout their ranges of distribution with particular reference to infraspecific levels of differentiations. More detailed faunistic surveys are bound to add to our knowledge of the distribution of the various species and the taxonomy of the genus.

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Notes on the Baya

Breeding Season 1957

BY

V. C. Ambedkar

In the 1957 season observations on the Baya Weaver Bird (*Ploceus philippinus* Linn.) in Poona were continued over a period of about 6½ months, April 18 to the end of October. I was unable to visit the Parbati Hill area daily till the end of May, but thereafter the place was visited every day either in the early morning or the evening. My notes tend to confirm most of the data previously published and also to open up several new ecological problems.

My first visit to the Parbati Hill area this year was on April 18. The area then was dry and sun-scorched and no bayas were about. The arid conditions lasted a couple of weeks more until the farmers started irrigating their 'wadis' from their wells. The runnels that carried this water soon became favourite bathing and drinking places for the bayas of the neighbourhood. A small party of male bayas in non-breeding plumage visited the area. It comprised 5 to 7 birds, but gradually more off-plumaged birds joined this group to form a flock of 50 to 60 individuals. They spent their time hopping about on the ground, gleaning grain and grass seeds. The sex was ascertained by dissection of 9 birds from this flock between 25 April and 2 May, all of which proved to be males. At this stage the birds seemed shy and nervous, promptly taking refuge in near-by trees even if they heard the sudden harsh notes of the Large Grey Babbler or the Rufousbacked Shrike. Later in the season, when the breeding was in full swing, they lost their extreme jitteriness, and once I even saw a cock baya make an assault on a straying Baybacked Shrike.

An interesting fact noticed was the close association of the Whitethroated Munia (*Lonchura malabarica*) with the bayas even at this pre-nesting stage. A small party of the munias was often seen in company with the baya flock, feeding and flying with it.

Immediately on the onset of the first rains on 28 May the flock, with as yet only a few individuals in partial breeding dress, split up into small parties of 4 to 7 which resorted to the various previous nesting sites in the area and the old nests of the last season, and started singing the characteristic building choruses. Occasionally there was a fight between two males for the possession of an old nest. Moulting into nuptial plumage became general and accelerated at this period, the first yellow appearing on the forehead and crown, then breast, and lastly on back. Though the flock had broken up into smaller parties the birds still continued to feed together and to roost in a swarm in a dense sugar-cane field about two miles west of the Parbati Hill area. This roost appeared to be exclusively for males and at it cocks not only from this area but also from the surrounding countryside foregathered every evening.

Fresh nest-construction started on June 3 after the remnants of the old nests had all been removed, but work practically stopped after the 'helmet' stage, as apparently no females were physiologically ripe as yet and none made their appearance in the colonies. On July 30, 8 or 10 hen-plumaged birds were observed amongst a large feeding flock of brightly coloured cocks. Two of these brown birds were trapped, and again on dissection proved to be males.

The lull in purposeful activity dragged on until August 4 when the first prospecting female showed herself in the area. During the two-month interval the birds had merely doodled with their unfinished nests, chiefly in the mornings, rarely bringing any fresh strips to add to them. Later in the day they had joined up again to form the large flock. Soon after the advent of the first female in the colony visits of more females rapidly increased. This revitalized the activity of the cocks and building was resumed in earnest, accompanied by the characteristic shivering and fluttering of wings to attract the prospecting hens. Two cocks once chased a visiting female for a distance of nearly half a mile while she zigzagged through the trees and bushes to escape, and was finally lost to sight. On a rough estimate there were at this period about 25 permanent nest colonies in this area, chiefly at the wells dotted about, including the Main or Control Colony at which most of our experimental work was done during this and previous seasons, and the total number of available nests (in 'helmet' stage) and males about 200. The first heavy influx of ready-to-breed females was perhaps slightly in excess of the nests available. They settled down almost simultaneously with the result that the hatching of the initial clutches of eggs was also almost synchronous.

It is worth recording that the 1957 monsoon in the Poona area (except towards the very end) was a perfectly steady and normal one. It was uninterrupted by spells of drought and cloudbursts and squalls that cause serious setbacks and delays in most years, sometimes completely annihilating well-advanced colonies and compelling the birds to start all over again. Thus the breeding activities which started unusually early (as did also the rains), though delayed by nearly a month and a half owing to the unreadiness of the females to breed, ran smoothly through and were successfully terminated by the end of September. The clutches of the first flush of laying in early August were larger and also resulted in a higher percentage of hatching success.

Table 1 shows the clutch size in 25 nests examined at random during the 1957 season in the Parbati Hill area:

TABLE 1

No. of eggs in clutch	*No. of nests*	*Total eggs*
1	3	3
2	2	4
3	9	27
4	8	32
5	2	10
8	1	8[1]
	25	84

Therefore, average size of clutch 3.3 as against 2.7 last year.

In a nest in colony KC3 *two* eggs were found to have been laid on one and the same day (10 Aug.) presumably by different females, while in two nests of the Control Colony it was observed that a fourth and last egg was added after a gap of 5 and 6 days respectively. The weight of those eggs, 2.2 gm. in each case, was definitely lower than the other eggs of the clutches. These delayed eggs hatched successfully, but with the corresponding delay. The hatchings were found dead the day following emergence, as a result of overcrowding and competition with the older chicks.

Weight of eggs

The average weight of 57 of the above eggs which were fresh was 2.38 gm.; maximum 2.8, minimum 2.1 gm. (cf. last year's 2.24 gm.; maximum 2.7, minimum 1.9 gm.)

As compared with last year's weights of the earlier layings in the Control Colony, this season's result is as follows:

Average weight of 1st egg (in 8 clutches) 2.28 gm.

Average weight of 2nd egg (in above 8 clutches) 2.39 gm.

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[1] This is quite abnormal and was probably the produce of more than one female. EDS.

It will be seen from Table 2 the average clutch size in 1957 was larger than in 1956. As mentioned earlier no fresh eggs were found in Control Colony in October, but the average clutch size in September was definitely higher than in September of the previous year.

TABLE 2

Average Clutch Size

Month	Year	
	1956	1957
August	3.0	3.0
September	2.3	3.2
October	2.6	No eggs being laid.
Mean	2.6	3.1

Incubation Period

The commonest incubation period in the 1957 season was found to be 15 days as against 16 days in 1956. Table 3 gives the details:

TABLE 3

Incubation Period

Period to hatching	*No. of cases observed*
13 days	no record
14 days	8
15 days	10
16 days	2
17 days	1
18 days	no record

Nestling Period

Table 4 shows the period between hatching and leaving the nest. The most common period in the 1957 season was the same as for incubation, viz. 15 days. It was observed that this year all the breeding activities were apparently speeded up.

TABLE 4

Days in nest	*Cases observed*
13	2
14	5
15	6
16	1
17	1

NESTING SUCCESS

Eggs

Control Colony in the 1957 season contained 7 males, 9 females, 9 complete and occupied nests, and 4 incomplete ones. However, one of the nests was out of reach for examination and could not be investigated. The total number of eggs in the 8 nests was 26, i.e. 3.2 per nest. Of these, 3 eggs got destroyed owing to rivalry amongst the cocks; two eggs vanished for some unknown reason (? ejected). The remaining 21 eggs all hatched successfully, i.e. 80.7%.

Young

Out of the 21 young, 15 left the nests successfully in due course, i.e. 71.4%—or 57.6% of the total number of eggs laid. Therefore, average success 1.9 chicks per nest as against only 1.00 last year.

SEX RATIO

Dissections confirmed last year's finding that males are somewhat in excess of females in the broods before the young leave the nest. This poses a highly intriguing situation which calls for a detailed study. The data for 1957, collected from random nests in this area, are given in Table 5.

TABLE 5

Date	Nest No.	Total young	♂	♀	o?
9 Sept.	1	3	2	1	
13 Sept.	2	1	1	—	
13 Sept.	3	2	—	2	
13 Sept.	4	4	3	1	
18 Sept.	5	3	1	1	1
19 Sept.	6	4	2	1	1
		17	9	6	2

Therefore, ratio of males to females was 3:2.

COPULATION

On 5 August 1957 at 6.45 p.m. the first copulation of a pair was observed in Control Colony. The act took place on the 'chin strap' of a nest in the 'helmet' stage. Next day the nest was completed, all except the entrance tube. The first egg was laid on 9 August, i.e. on the fourth day after the initial copulation.

For two years successively I had observed copulations of the baya only as above, i.e. on the cross-bar of nests in the 'helmet' stage, but in the 1957 season I recorded one away from a nest. At 9 a.m. (18 August) a female solicited on a branch of a tree adjacent to the colony with shivering wings and partially upraised tail, upon which two cocks from the colony promptly rushed up to her and tried to mount, and one succeeded in copulating with her. This was undoubtedly an instance of promiscuous mating as suggested by Sálim Ali in our earlier paper (*JBNHS* 54: 502—August 1957).

ABNORMAL NESTS

I have been on a special look-out for abnormal nests of the baya in the Poona area since 1953. It is extraordinary to note that during the 1957 season not a single case of nest abnormality was observed. The explanation may well lie in the fact that this breeding season was an unusually short and steady one, unmarred by any setbacks as compared with the past four years. As mentioned earlier, building activities were completely over by the end of September, not a single fresh nest or egg being found in October. The suggestion is that when, due to meteorological interruptions, the birds are obliged to re-start breeding activities late in the season, it becomes imperative for them to speed up their activities. In order to make up for lost time they then tend to take short cuts in building by makeshift additions to a derelict nest still hanging, rather than remove it entirely before commencing a fresh one in its place. Thus apparently are brought about the 'tandem' nests and other abnormalities previously described.

DATA FROM RINGING

In the 1956 season all the adult birds in Control Colony (5 males, 10 females) and 9 nest-young had been ringed with coloured plastic rings in an attempt to determine their degree of faithfulness to the nest site. It is significant that none of these individuals returned to the same colony to breed in 1957. However, one of the marked young (No. 27, since determined to be a female) was discovered breeding in a different colony at a distance of about four furlongs from its birth place. A second bird (No. 14, also determined to be a female), also ringed as a nestling in the same neighbourhood (KC3 Colony), was likewise found breeding in another colony situated some 300 yards from her place of birth. Curiously enough both these young and inexperienced females were breeding in one and the same colony (KC 1) which contained no other completed and occupied nests besides these two.

One male (No. 41), who was used as a decoy for trapping birds in the 1956 season and who had escaped during the experiment, was also observed in a different nest colony (No. 9), but not definitely ascertained to be breeding there. Out of a total of 36 birds colour-ringed in 1956 only the above three birds were re-discovered in the 1957 season, i.e. 8.3%.

Case history of Female No. 27

Hatched out in nest No. 6 (Control Colony) on 6 September 1956. Marked on 14-9-1956 with coloured rings red/white on right leg when nine days old. Left nest on 21 September, i.e. on 15th day. Re-discovered breeding in August 1957 in nest colony KC1 situated about four furlongs NE. of Control Colony where ringed. Laid first egg on 8 August 1957, i.e. when 336 days (about 11 months) old, and three more eggs on successive days. They measured (1) 19.0 × 15.0, (2) 20.0 × 14.5, (3) 19.5 × 15.0, (4) 19.5 × 14.5 mm. Of these, only one egg hatched in due time. One egg of the clutch was accidentally broken; the other two disappeared during incubation; the young died soon after hatching.

On the first few occasions when I approached the nest for daily inspection of the contents, the incubating female did not leave till I touched the nest although her mate was uttering anxious alarm notes all the while. She apparently did not understand the significance of the agitated calls. But after two days she had learnt the meaning of the male's warning notes and flew out as soon as they were uttered long before the nest was touched, and sometimes even when I was yet at a distance.

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Two New Species of *Echinoderella* (Phylum Kinorhyncha) from the Bay of Bengal

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(*With two plates*)

The phylum Kinorhyncha or Echinodera is small and little known to the general zoologist. All the representatives of this phylum are marine and under 1 millimetre in length. No kinorhynchs have previously been reported from the Bay of Bengal. The two species described in this paper were obtained from screenings of bottom mud exposed at low tide on Sonadia Island near Cox's Bazar, East Pakistan. They were collected in January, 1956.

Identification of the Kinorhyncha is based on body dimensions to some extent, but especially on the number, position, and length of the various spines and setae. The difficulty of identification results from their small size and relative scarcity. It has been assumed that there is little variation in body dimensions within a species and an absolute fixity of the number, position, and length of the spines. The presence of one species in our collection in large numbers enables us to throw some light on this assumption. Within a single population, at least, there seems to be an exceedingly limited range of variation.

A further difficulty in identification comes from the fact that the only difference between the genera *Echinoderella* and *Echinoderes* is the presence of pigmented eyespots in the latter and their absence in the former. However, it is well-known that the pigment of the eyespots fades after formalin fixation. Hence, observation must be made of specimens in life or shortly after fixation in order to distinguish between these two genera.

DESCRIPTION

The body of both the new species of *Echinoderella* is divided into 13 tergites or zonites. Each zonite consists of one dorsal or tergal plate and two ventral or sternal plates. Overlapping the posterior margins of zonites 3 to 12 are rows of tiny spines or setae. There are relatively fewer scattered larger setae on the surface of these zonites.

The anterior zonites bear more scattered setae than the posterior; setae are lacking near the mid-ventral line.

The first zonite forms the head, covered with circlets of spines or scalids. The head is retractile within the second zonite, which is covered by 16 little plates or placids. At the anterior margin of the placids are found specialized scalids, consisting of a cuticular plate and 2 setae with bristles. At the anterior of the head is an oral cone containing the oral stylets. The short oesophagus opens into a muscular pharynx, which empties into a straight tubular intestine. Pigmented eyespots are lacking in both species.

Echinoderella bengalensis new species (Fig. 1, A).

Length extended 400-438 μ, excluding the tail spines. Length retracted 350-368 μ. Maximum body diameter 58-77 μ. Ratio of length to breadth 7:1 to 5.7:1. Lateral spines on zonites 7 and 10, 15 μ long. Mid-dorsal and sublateral spines absent. Paired tail spines, 67-77 μ long. Anal cerci 23 μ long. Scalids 36 μ long. Two pairs of penial setae or copulatory spicules protruding from the tail end of the male, just to the inside of the anal cerci, 32 μ long. Paired ovaries in the female on either side of the intestine. Three mature ova observed in one female, two on one side and one on the other, measuring about 80×45 μ.

Cotype specimens: Personal collection, K 1.

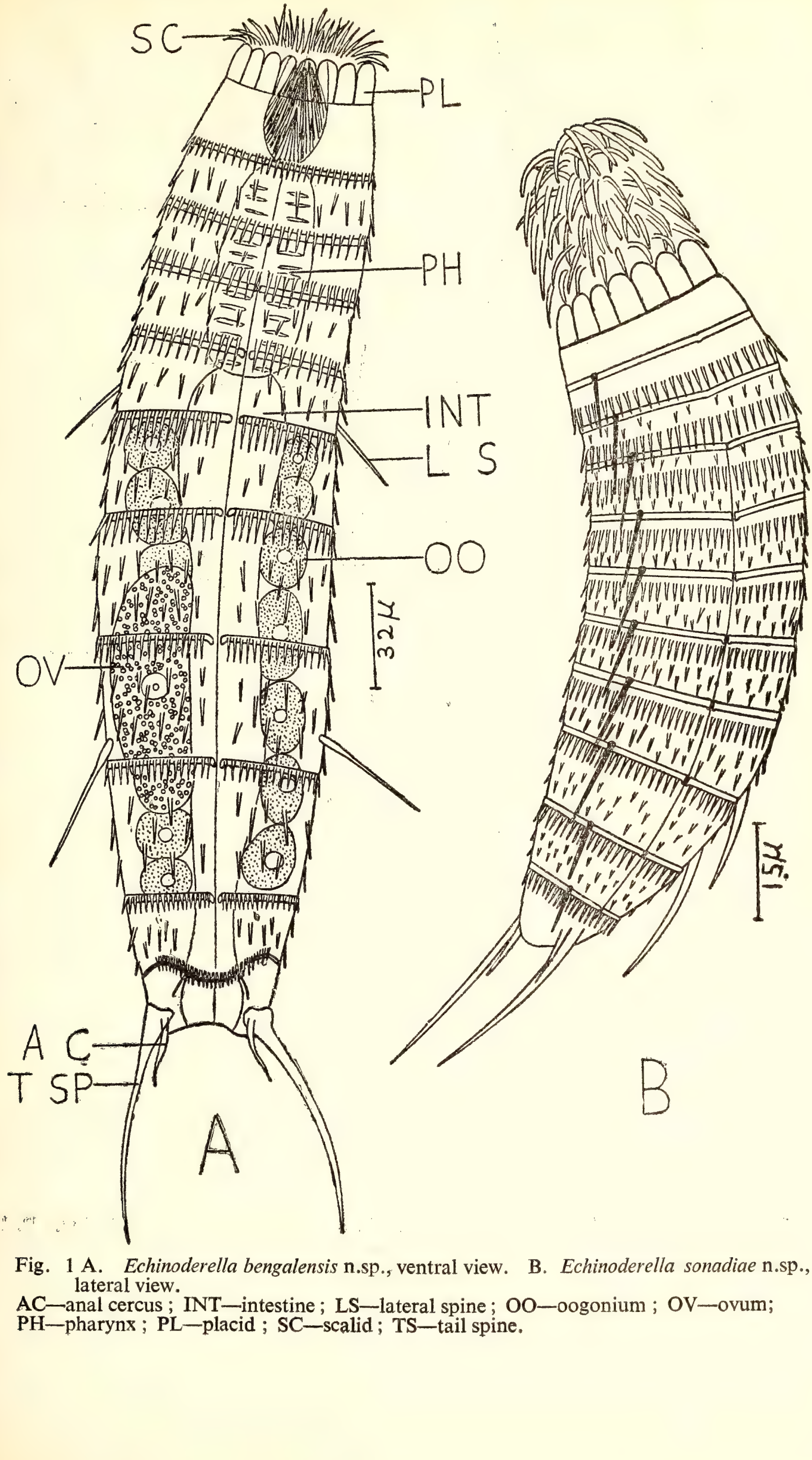
Echinoderella sonadiae new species (Fig. 1, B).

Length extended 248 μ. excluding the tail spines. Maximum body diameter 60 μ. Ratio of length to breadth 4:1. Mid-dorsal spines on zonite 11 and at the border of zonites 10 and 11, 38 and 27 μ long respectively. Sublateral sclerotized spines on zonites 4-13, the longest about 23 μ. Paired tail spines 48 μ long. Anal cerci 15 μ long. Scalids about 22 μ long. (3 specimens were observed but 2 were lost before measurements were taken.)

Holotype female: Personal collection, K 2.

DISCUSSION

In their particular combination of several characters the two species of *Echinoderella* described in this paper are seemingly new to science. From observation of 25 specimens of *E. bengalensis* it was found that the lateral spines are not always observable. Sometimes they are pressed close to the body and are seen only after careful focusing with an oil immersion lens. In a few specimens the anterior pair of spines seems to be lacking entirely. Therefore, the erecting of new species on the basis of number of dorsal, sublateral, or lateral, spines is a risky procedure unless observation is made of several specimens.


SC
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T SP
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B

Fig. 1 A. *Echinoderella bengalensis* n.sp., ventral view. B. *Echinoderella sonadiae* n.sp., lateral view.
AC—anal cercus ; INT—intestine ; LS—lateral spine ; OO—oogonium ; OV—ovum; PH—pharynx ; PL—placid ; SC—scalid ; TS—tail spine.

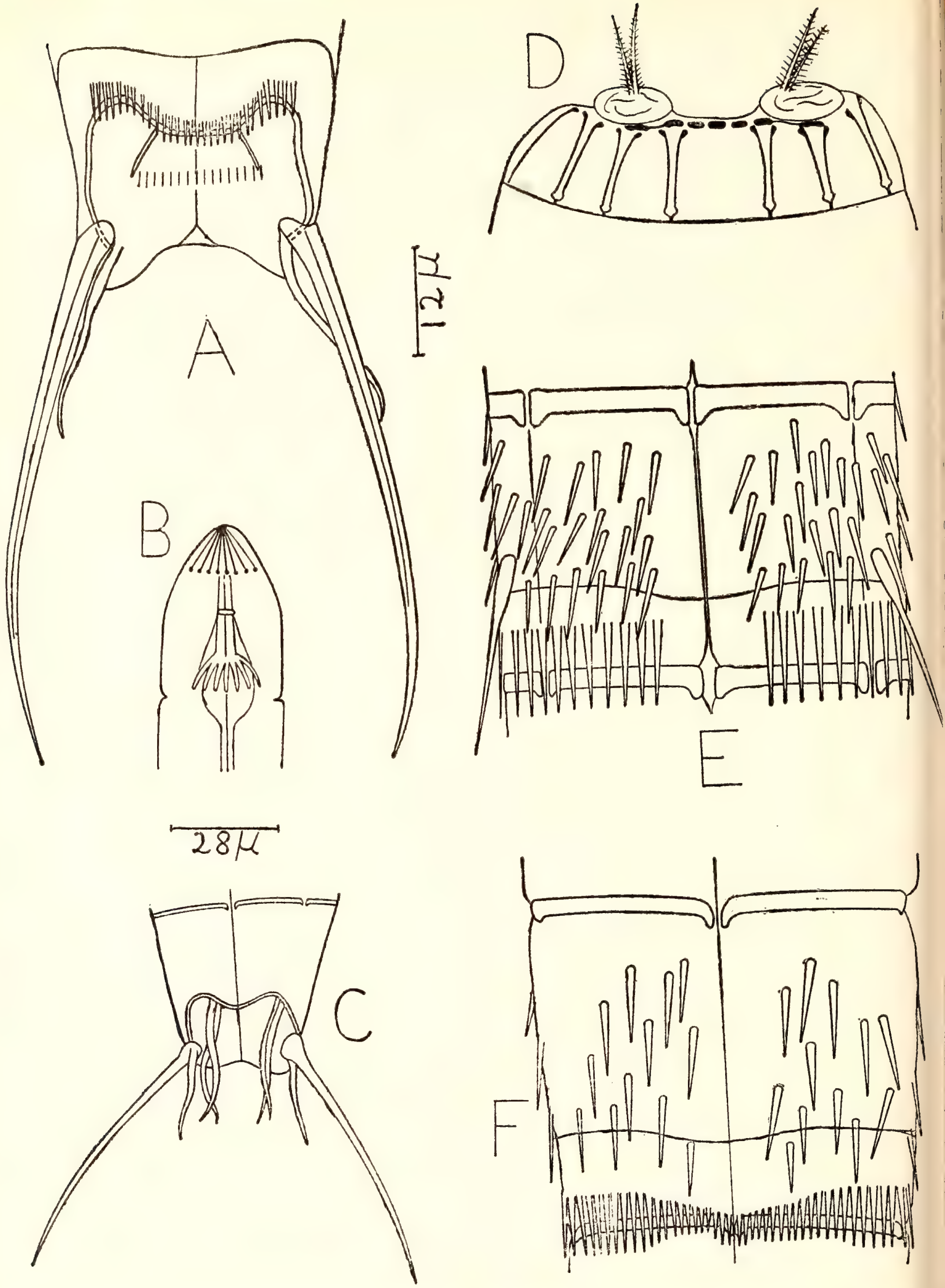

Fig. 2. Details of *Echinoderella bengalensis* n.sp. A. Posterior of female, ventral view. B. Head extended. C. Posterior of male, ventral view. D. Zonite 2, showing specialized scalids of posterior circle. E. Zonite 7, ventral view. F. Zonite 11, ventral view.

ACKNOWLEDGEMENT

Because of insufficient literature on the Kinorhyncha to ensure reliable identification the author sent descriptions and rough drawings of the two species described here to Prof. A. Remane, Zoological Institute, University of Kiel. I am indebted to him for kindly identifying the two species as new to science and for pointing out some recent literature on this group.

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Some Rare Indian Aphids

BY

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INTRODUCTION

Several species of aphids have recently been added to the collections of this Institute, some of which have not been previously reviewed by the writer. Of these two are new to India, four though previously noted require revision, and two had sexual forms in new localities under conditions different from those observed before. Since very little information is available on these aphids in India, the observations made along with their present systematic position and economic status are discussed in this paper. For certain other species, food plants not noted before are added. Apart from the species collected by the writer in South India, specimens were received from Dr. V. Prabhakara Rao of the Commonwealth Institute of Biological Control, Bangalore Station, collected in that area, and from Sri. R. N. Azad, Plant Virus Research Laboratory, Simla, collected in the western Himalayas. The identifications have been verified through the kind courtesy of Dr. D. Hille Ris Lambers, Netherlands.

1. **Aulacorthum solani** (Kaltenbach)

Aphis solani Kaltenbach, 1843, Mono. d. Pfanzenlause.
Siphonophora convolvuli Buckton, 1876, Mono. Br. Aphides.
Myzus pseudosolani Theobald, 1922, *S.E. Agric. Coll. Bull.* I.
Aulacorthum solani (Kalt.) Hille Ris Lambers, 1948, *Temminckia* VIII.

Morphological features. The nymphs and adult apterous females are whitish to pale green with a darker green or brownish patch near the siphunculi. The head is scabrous with a straight vertex and large antennal tubercles with parallel inner sides. The antennae are longer than the body with 1 or 2 rhinaria near the base of the III antennal segment. The processus terminalis is 4 or 5 times the base of the VI segment. The body hairs are short and slightly swollen at the tip. The abdomen has dark intersegmental markings in pairs on each segment. The siphunculi are pale and cylindrical except for the apex which is brown. The cauda is conical with about 8 hairs. The alate female is darker with pale sclerotic bands on the sides. The III antennal segment has about 14 circular rhinaria.

Host plants and distribution. This aphid occurred in Ootacamund in the Nilgiris district in south India (elevation 7,200 ft. above m.s.l.). It was found on *Digitalis purpurea* on the lower surface of leaves in bushy portions of the plant. It was noted in January and February.

In Europe and America it is said to be polyphagous feeding on a wide range of hosts. Jacob (1944) observed overwintering of apterous viviparous females in Britain. The single apterous females containing embryos resting without reproducing nymphs on the same host in Ootacamund along with the shrunken integument lead one to believe that similar conditions may be prevalent in this locality also.

According to Hille Ris Lambers (1949) the aphid is distributed in Europe, North America, and New Zealand. Essig (1947) gives China, Japan, Africa, and Hawaii also. This is the first time it is being noted in India. It has evidently been introduced into this country along with some commercial products in recent years.

Economic importance. In Europe and America this aphid, commonly called the Foxglove Aphid, is of considerable importance as a vector of several virus diseases of potato. In south India it has not yet been noted on potato and its injury to *Digitalis* is rather slight.

2. **Liosomaphis berberidis** (Kaltenbach)

Aphis berberidis Kaltenbach, 1843, Mono. d. Pflanzenlause.

Morphological features. The apterous viviparous female has short, pale antennae with the processus terminalis just longer than the base. The head, thorax, and abdomen are pigmented with dark sclerotic bands across each segment. The markings on the abdominal segments 3 to 5 coalesce to form a central broad patch. The siphunculi are pale, smooth, narrow at the base to about the third and swollen afterwards, the swollen portion being about double of the narrow portion in width. Two or three transverse striae are seen below the expanded flange. Cauda is pale, about half of the siphunculi, with a conical apex and 5 hairs.

Host plant and distribution. This aphid was noted at Simla in the western Himalayas (coll. R.N. Azad) during September. So far it was known only in Europe, and the present record has to be regarded as the first from outside the Palaearctic Region. The aphid has possibly been introduced into this country recently and, since the climatic conditions in Simla are similar to those in temperate regions, the aphid would appear to have survived there.

Economic importance. The aphid is not of any importance as it attacks only a hardy perennial which is not cultivated.

3. **Forda hirsuta** Mordvilko

Forda hirsuta Mordvilko, 1928, Bestimer der Insekten.
Forda orientalis George, 1928, *J. & Proc. Asiat. Soc.* 20.

Morphological features. The apterous viviparous female has a lightly pigmented head with many short and spiny hairs and small warts all over. Antennae are pale brown all through with many hairs which are as long as those on the body; the I segment has 8, the II 13, III 23, IV 11, and V 16+4. The hairs on the tergites in the thoracic and abdominal regions are distributed in large groups on the margins. The 8th tergite has 16 hairs. The cauda is rounded with about 20 short and stout hairs. The rostrum reaches the 3rd coxa with the last segment elongate and as long as the 2nd joint of the hind tarsus; it has an acute apex and has 12 short hairs apart from the apical ones. The tarsal formula is 7 hairs each with 2 empodial hairs.

Measurements of apterous female, in mm.

Length of body	Antennae	Antennal segments					Last segment of rostrum	2nd tarsus of hind leg
		I	II	III	IV	V		
2.46	.85	.11	.12	.28	.14	.15 + .05	.22	.22

Host plants and distribution. The aphids were found feeding on the roots of *Pennisetum typhoides* in Coimbatore during October. George (1928) recorded it on *Sorghum vulgare* (=*Andropogon sorghum*) in Coimbatore. Apart from south India it has been noted only in central Asia, Iran, and Turkey.

This aphid is very similar in appearance to the common grass-root aphid of Coimbatore, namely *Tetraneura hirsuta* (Baker), but the pale yellow colour of the living form, the absence of siphunculi, and the absence of long hairs on the margins make it easily recognisable.

Dr. D. Hille Ris Lambers points out that the south Indian form is identical with the central Asian form, and therefore it is here treated as a synonym.

4. **Tetraneura javensis** van der Goot

Tetraneura javensis v.d. Goot, 1917, Contr. a la Fauna des Indes Neerland.
T. cynodonti subsp. *coimbatorensis* George, 1928, *J. & Proc. Asiat. Soc.* 20.

Morphological features. The apterous viviparous female has a sclerotic brown head with long hairs which are about twice the basal breadth of the III antennal segment. The antennae are short and dark brown with many hairs which are only about half of those on the vertex. The abdominal segments have long marginal hairs in groups of 3 or 4 on each segment. The tergum is clear except for intersegmental, pleural, brown spots on the anterior segments and complete bars on the 7th and 8th tergites. Wax plates are found on the margins in between spiracles and are composed of a large cell surrounded by 10 to 20 small ones with thick walls. Another row is found spinally which has only 2 or 3 small glands surrounding the central one. The siphunculi are brown and conical with a constriction below the large flange. The cauda is rounded with about 10 hairs and the anal plate also rounded with 12 hairs. The rostrum is short, reaching just past the 2nd coxa with the apical segment elongate having a pointed tip and 4 hairs apart from the apical ones. The legs are brown with thin hairs.

Host plants and distribution. This aphid occurred on sugarcane in Perianaikenpalayam near Coimbatore (coll. K. R. Nagarajan) in January and February. The infested plants were turning yellow (Nagarajan, 1957) and getting stunted in growth. *Solenopsis geminata* was attending on it, but did not produce the characteristic ant holes near the plants.

The previous record of this aphid in India was by George (1928) in Coimbatore on sugarcane. It has been noted also in Java on the same plant. It can be easily distinguished by the whitish colour of the body and the darker colour of the legs and antennae of the living forms.

The suggestion of Dr. D. Hille Ris Lambers that the south Indian and the Javanese forms may be the same has been accepted here and the former treated as a synonym.

5. **Rhopalosiphum rufiabdominalis** (Sasaki)

Toxoptera rufiabdominalis Sasaki, 1899, Hok. Agr. Expt. Sta. Rt. 17.
Rhopalosiphum avenae F. George, 1928, *J. & Proc. Asiat. Soc.* 20.

The rice-root aphid had been confused with other cereal aphids, till Doncaster (1956) drew attention to the distinguishing features especially the rusty coloration around the siphunculi in the living forms. George (1925, 1928) noted this aphid attacking the roots of *Eleusine coracana* and *Echinochloa colona* (=*Panicum colonum*) in Coimbatore from September to November. In the present case the aphids were captured as alates on *Eleusine coracana* in Coimbatore from May to June when there was cool and humid weather with rain. It is apparently a casual visitor to this locality as no regular colonies are found on these plants. In north India it appears to be more common as Das (1918) recorded it from various plants in central India, and Banerjee and Basu (1955) from the eastern region.

6. **Rhopalosiphum padi** (Linnaeus)

Aphis padi Linnaeus, 1758, Sys. Nat. X.

This is another aphid affecting cereal crops which closely resembles the last. Eastop (1955) and Doncaster (1956) have shown that the species can be distinguished by the smaller number of hairs on the 8th abdominal tergite as well as the shorter hairs on the antennae and body.

The aphid was noted in the western Himalayas (coll. R. N. Azad) at Simla feeding on wheat in November. Banerjee and Basu (1955) also recorded it from the eastern region in north India. So far it has not been found in south India.

7. Males in **Rhopalosiphum nymphaeae** (Linnaeus)

This is an aphid well known all over the world for its habit of feeding on *Prunus* sp. as a primary host, and migrating to aquatic plants in summer. In south India it has so far been noted only on its secondary hosts on the hills as well as the plains. Sexual forms had yet not been secured in any locality in India. Alate males have now been obtained in Coimbatore from a colony feeding on *Eichhornia crassipes* in January. The production of males on its secondary host in a comparatively warm region where the primary hosts are not available has necessarily to be abortive. The temperature and photoperiod of the season should have been conducive to the production of the sexual forms. However, colonies on the secondary hosts in Nilgiri Hills during the same period have not yet been found to produce any sexual forms. Extensive colonies were found on *Aponogeton monocharia* living only by parthenogenesis.

8. Males in **Schoutedenia emblica** (Patel & Kulkarni)

Apterous males and oviparous females had been reported (David & Hille Ris Lambers 1956) in *Schoutedenia emblica* subsp. *andhraka* David & HRL. from the east coast of south India, in the monsoon season. *Schoutedenia emblica* (Patel & Kulkarni) occurring on the west coast in March contained apterous males similar to the ones reported before. Since the temperature and photoperiod of summer is different from that of the monsoon season, the production of sexual forms under these conditions in the plains of India should be of considerable interest.

9. Oviparous females in **Brevicoryne brassicae** (Linnaeus)

The mealy cabbage aphid is known all over the world to be an injurious pest of cruciferous vegetables in temperate regions, and has been found to occur to a limited extent in north India. It had so far been known only from its parthenogenetic forms in this country. Specimens collected from Simla in March on cabbage (coll. R. N. Azad) contained oviparous females. Simla experiences severe winter with snow as in the temperate regions. In March, however, the conditions are similar to those of the northern spring. It is rather unusal to find oviparae in this season.

This aphid has not so far been found in south India, either on the plains or on the hills.

UNRECORDED FOOD PLANTS OF SOME SOUTH INDIAN APHIDS

Aphis craccivora Koch. *Carica papaya* (Papaya). Small colonies were noted on the leaves in March which made the leaves curl.

Aphis gossypii Glover. *Achras sapota* (Sapota), *Bidens pilosa, Coniza* sp., *Emilia sonchifolia,* and *Lawsonia alba* from January to March; *Polyalthia longifolia* (coll. V.P.Rao) in Bangalore; *Ocimum sanctum* in July; *Pimpinella monoica, Solanum nigrum, S. seaforthianum,* and *S. wenlandi* in February.

Aphis malvoides van der Goot. *Emilia sonchifolia.*

Macrosiphum hellebori Theobald & Walton. *Agrostemma coelirosa.* The record of *M. euphorbiae* (Thomas) on *Echeveria* sp. (David 1956) refers to this species.

Schizaphis graminum (Rondani). *Sorghum vulgare* seedlings in July.

Tetraneura hirsuta (Baker). *Setaria italica* in Coimbatore and *Eleusine coracana* in Pattambi in central Kerala in October. Due to the compact nature of the laterite soil of the region, the aphids were found crowding on the surface of the soil at the base of the stem, attended by red ants.

Toxoptera aurantii Boyer de Fonscolombe. *Caesalpinia coriaria* in February in Coimbatore, and *Mangifera indica* and *Saccharum officinarum* in Bangalore (coll. V. P. Rao).

Toxoptera odinae (van der Goot). *Achras sapota,* in February.

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The Food and Feeding Habits of Some Freshwater Fishes of Madras State

BY

M. D. MENON AND P. I. CHACKO

INTRODUCTION

A study of the food and feeding habits of fishes is undoubtedly very important in any fisheries research programme. Recently Hynes (1950) and Pillay (1952) have reviewed the various methods employed in the study of the food of fishes, and Rounsefell and Everhart (1952) have described these different methods in detail.

In 1942, the Indian Council of Agricultural Research sponsored a study on the bionomics of freshwater fishes under the Madras Rural Piscicultural scheme and detailed studies on the food of the economically important species including the 'larvicidal fishes' of the State were undertaken at the Fresh Water Biological Research Station, Madras. An account is given in this paper of the food and feeding habits of half-grown and adult stages of these fishes[1]. In the present study no attempt is made to include food analysis of species collected from 'cultural waters' as the data obtained therefrom differs considerably from that for the same species found in 'natural waters', from where the material for this study was collected.

Mookerjee *et al.* (1946) classified the feeding habits of some fishes on the basis of the presence of the maximum percentage of the types of food in the alimentary canals. From the point of view of the types of food chosen, Kesteven (1946) classified the fishes into herbivorous, carnivorous, and polyphagous and indicated that within these three major groups the fishes should again be classified according to the ecological conditions under which they feed. Ganapati and Chacko (1950) grouped several fishes of piscicultural importance into surface feeders, column feeders, and bottom feeders. This, though useful for general observations, becomes inapplicable while suggesting the combinations of fishes for fish-cultural operations. For instance, it is necessary to differentiate plankton feeders (surface feeders) into phytoplankton and zooplankton feeders when the suitability of a fish as cyclopscidal fish is examined for introduction in a tank. In some cases, the utility of fish for the eradication of several of the molluscs that act as intermediate hosts for some of the helminth parasites may have to be assessed. In such instances it is necessary that the grouping 'Browsers' be split into various sub-groups according to the taxonomic position of the organisms fed upon. Therefore, it is necessary to classify fishes according to the problems that are tackled, and an outline classification on these lines, followed by descriptive notes is given below:

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[1] The nomenclature used here is according to Day (1889).

1. Surface feeders	Plankton feeders (A). Insectivores (B).
2. Browsers or bottom feeders	feeding on filamentous algae, molluscs, and worms.
3. Vegetable feeders	feeding on aquatic plants.
4. Column feeders	feeding mostly on larger crustacea, e.g. shrimps and prawns.
5. Piscivores	

GROUP I—SURFACE FEEDERS[1]

This group deals with fishes that feed on plankton and insects:

A. PLANKTON FEEDERS: The typical plankton feeders as determined from the percentage composition of their food (*vide* Table I) can again be split into (*a*) Phytoplankton feeders, and (*b*) Zooplankton feeders.

(*a*) Phytoplankton feeders: Fishes of this group are found to have in their guts food composed of phytoplankton forming about 28 to 68% consisting of the following:

Chlorophyceae: *Ankistrodesmus, Chroococcus, Closterium, Coelastrum, Cosmarium, Crucigenia, Eudorina, Pandorina, Pediastrum*, and *Scenedesmus*.

Myxophyceae: *Merismopedia, Microcystis*, and *Spirulina*.

Diatoms: *Amphora, Coconeis, Cyclotella, Cymbella, Eunotia, Fragillaria, Gomphonema, Melosira, Navicula, Nitzschia, Pinnularia, Rhopalodia, Surirella, Synedra*, and *Tabellaria*.

The following fishes can be grouped under this head:

Barbus amphibius, B. aurelius, B. chola, B. dubius, B. filamentosus, B. sophore, B. ticto, Catla catla, Cirrhina cirrhosa, Labeo boga, Osteocheilus thomassi, Thynnichthys sandkhol, Lebistes reticulatus, and *Macropodus cupanus*.

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[1] The analysis of the food of fishes given has been done volumetrically and the percentages of the various groups are hence by volume.

(*b*) Zooplankton feeders: A major percentage of the food of the fishes of this group is made up of zooplanktonic organisms such as:

Copepods: *Cyclops* spp., *Mesocyclops, Pseudodiaptomus* spp., and *Diaptomus* spp.
Protozoans: *Arcella, Difflugia, Phacus, Peridinium,* and *Euglena.*
Rotifers: *Noteus, Diurella,* and *Brachionus.*
Cladocerans: *Diaphanosoma* spp., *Daphnia* spp., *Ceriodaphnia* spp., and *Macrothrix* spp.

The fishes falling under this group are *Ambassis nama, A. ranga, Barbus sarana, B. vittatus,* and *Chela clupeoides.*

B. INSECTIVORES: Of the surface feeders, fishes show preferential feeding habits by taking mainly the insects and their larvae in various stages of metamorphosis, such as *Chironomus,* Ephemeropteran larvae, Dipteran larvae, *Plea, Notonecta, Corixa, Ranatra, Odonata* larvae, and *Cybister* and other water beetles. From an examination of the food (Table II) the following fishes can be classified as mainly insectivorous:

Anabas scandens, Barilius bakeri, B. bendelisis, Chela argentea, C. bacaila, C. untrahi, Danio aequipinnatus, Rasbora daniconius, Etroplus maculatus, Gambusia affinis, and *Aplocheilus lineatus.*

GROUP II—BROWSERS OR BOTTOM FEEDERS

The fishes feeding on filamentous algae, molluscs, and worms and those in whose stomachs sand grains in fair proportion are found have all been placed under this group (*vide* Table III). Generally, the filamentous algae are found in shallow areas or attached to rocks and such other anchorages at the margins. The mollusca are often seen on the algae or on the submerged stones. In view of these ecological conditions, fishes having in their stomachs a good percentage of filamentous algae have also been placed along with the typical bottom feeders.

The main composition of the diet of the fishes of this group is as follows:

Filamentous algae: *Gleotrichia, Lyngbia, Nostoc, Oedogonium, Oscillatoria, Spirogyra,* and *Ulothrix.*
Molluscs: *Melanoides tuberculatus,* and *Indoplanorbis exustus.*
Worms: *Nais.*

Fishes under this head are *Barbus carnaticus, B. stigma, Cirrhina reba, Labeo boggut, L. calbasu, L. fimbriatus, L. kontius, Nuria danrica, Lepidocephalus thermalis, Pangasius pangasius, Ophiocephalus punctatus,* and *Etroplus suratensis,*

GROUP III—VEGETABLE FEEDERS

Fishes classified under this group are found to have their diet composed mainly of the higher aquatic plants, dead leaves and seeds of land plants, and other vegetable debris (Table IV).

The following fishes can be placed under this group *Barbus hexagonolepis, B. curmuca,* and *Osphronemus goramy.*

GROUP IV—COLUMN FEEDERS

Under this are grouped those fishes that are found to be feeding on the faster moving and larger crustaceans like shrimps (*Caridina*).

Only *Barbus chrysopoma* has been found to be feeding mainly on the larger crustaceans and is classified as a typical column feeder (*vide* Table V).

GROUP V—PISCIVORES

Lastly are the fish that are found to be feeding predominantly on fish (*vide* Table VI). Both young and adolescent fish have been found in their gut contents. The piscivores have been observed to select advantageous positions in natural waters to capture fish that try to swim rapidly below anicuts and regulators.

The following fishes can be classified as typical piscivores:

Notopterus notopterus, Callichrous macrophthalmus, C. pabda, Macrones seenghala, Saccobranchus fossilis, Silonia silonia, Wallago attu, Glossogobius giuris, Gobius biocellatus, and *Ophiocephalus striatus.*

APPLICATION OF DATA ON FOOD AND FEEDING HABITS TO FISH CULTURE

Ganapati and Chacko (1950) while making suggestions for stocking fish ponds in Madras stated that one of the problems of fish farm management is 'to work on the combination of species that will produce the maximum yield of edible fish for each type of pond'. The composition of such combinations will vary depending on the types of available food items. 'So a pond should be stocked with surface feeders, column feeders, and bottom feeders to get maximum production. As a general rule, it is advisable to stock a pond with 50% of fingerlings of surface feeders, 25% of column feeders, and with 25% of bottom feeders'. These proportions are based on the fact that the region of biological productivity is confined to the regions of photosynthesis and that the bottom region is the zone of biological reduction. The same authors have suggested various combinations with respect to the types of food available in various types of tanks.

Apart from food, many of these fishes can be utilised from the point of view of public health. Many waters emit a foul odour when having blooms of some algae. The blue-green alga *Microcystis,* is one that gives rise to such periodical blooms creating very foul odour. *Cirrhina cirrhosa, Labeo boggut,* and *Barbus dubius* are good for a very successful combating of these blooms. Very thick growths of *Hydrila, Oscillatoria,* and *Spirogyra* have been successfully cleared by *Tilapia mossambica, Labeo calbasu,* and *Catla catla* in the Chetput Fish Farm. The importance of food and feeding habits data on fishes becomes very apparent when their usefulness for control of water-borne diseases is examined. Thus *Gambusia affinis, Aplocheilus lineatus, Rasbora daniconius,* and *Etroplus maculatus* have been used very successfully for the control of mosquito larvae and *Ambassis ranga, A. nama,* and *Chela clupeoides* have proved to be very good cyclopscidal fishes. Chacko and Kuriyan (1949) observed the occurrence of large numbers of molluscs in the stomachs of *Catla catla.* The culture of this carp in rural waters may help the control of molluscs which are the intermediary hosts of many of the helminth parasites.

Most of the piscivores can be very well used for a successful fish culture in swamps, rock quarry pools, and tanks where net fishing is a problem and line fishing alone is possible.

ACKNOWLEDGEMENT

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PERCENTAGE COMPOSITION OF THE FOOD GROUPS IN THE GUT CONTENTS OF THE FRESHWATER FISHES OF MADRAS

	Name of fish	Number of specimens examined	Unicellular algae	Filamentous algae	Higher plants	Protozoans	Copepods	Crustaceans	Insects	Fish	Molluscs	Worms	Mud and sand	Amphibians
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
						Table I—Plankton feeders								
1.	*Ambassis nama*	210	0.2	—	—	16.4	45.8	16.1	21.3	—	—	—	0.2	—
2.	*A. ranga*	230	0.4	—	—	10.1	46.9	25.7	16.5	—	—	—	0.4	—
3.	*Barbus amphibius*	260	62.0	18.0	—	—	12.0	1.0	5.0	—	—	—	2.0	—
4.	*B. aurelius*	311	32.0	24.0	4.0	6.0	13.0	—	15.0	—	—	—	6.0	—
5.	*B. chola*	250	68.0	12.0	—	—	12.0	4.0	—	—	—	—	4.0	—
6.	*B. dorsalis*	210	37.5	15.0	—	6.0	11.6	8.3	20.0	—	—	1.6	—	—
7.	*B. dubius*	136	29.1	24.1	—	1.0	12.5	2.0	17.2	—	12.1	—	2.0	—
8.	*B. filamentosus*	175	28.0	22.0	—	—	24.0	8.0	10.0	—	—	—	8.0	—
9.	*B. sarana*	150	5.3	8.0	—	16.6	21.6	—	8.6	20.0	16.6	—	3.3	—
10.	*B. sophore*	250	44.0	24.0	—	—	16.0	2.0	10.0	—	—	—	4.0	—
11.	*B. ticto*	270	34.0	25.0	—	—	20.0	3.0	10.0	—	—	—	8.0	—
12.	*B. vittatus*	145	32.0	18.0	—	—	34.0	1.0	8.0	—	—	—	7.0	—
13.	*Catla catla*	1,500	28.0	10.0	30.0	5.0	10.0	10.0	—	—	3.0	—	4.0	—
14.	*Chela clupeoides*	134	4.0	2.0	—	2.0	58.0	16.0	18.0	—	—	—	—	—
15.	*Cirrhina cirrhosa*	360	52.0	19.0	—	8.0	14.0	7.0	—	—	—	—	—	—
16.	*Labeo boga*	110	39.0	22.0	—	8.0	15.0	12.0	—	—	—	—	4.0	—
17.	*Lebistes reticulatus*	440	30.0	15.0	—	5.0	10.0	10.0	27.0	—	—	3.0	—	—
18.	*Macropodus cupanus*	320	35.0	20.0	—	5.0	—	20.0	15.0	—	—	—	5.0	—
19.	*Osteocheilus thomassi*	176	60.0	5.0	—	10.0	20.0	—	—	—	5.0	—	—	—
20.	*Thynnichthys sandkhol*	184	50.0	12.0	—	10.0	18.0	10.0	—	—	—	—	—	—

Table II—Insectivores

1.	*Anabas scandens*	185	—	2.0	13.0	—	—	10.5	40.5	14.0	19.0	—	1.0	—
2.	*Aplocheilus lineatus*	413	22.0	—	—	9.0	11.0	—	58.0	—	—	—	—	—
3.	*Barilius bakeri*	164	5.0	5.0	—	—	5.0	10.0	70.0	—	5.0	—	—	—
4.	*B. bendelisis*	128	8.0	10.0	2.0	1.0	10.0	13.0	46.0	—	8.0	1.0	1.0	—
5.	*Chela argentea*	527	15.0	10.0	—	5.0	12.0	3.0	55.0	—	—	—	—	—
6.	*C. bacaila*	213	3.4	9.2	—	—	—	—	64.6	22.8	—	—	—	—
7.	*C. untrahi*	385	4.0	3.0	—	3.0	22.0	2.0	66.0	—	—	—	—	—
8.	*Danio aequipinnatus*	440	16.6	20.8	8.3	—	8.5	—	45.6	0.2	—	—	—	—
9.	*Etroplus maculatus*	450	6.6	5.6	1.6	2.0	28.2	1.0	31.0	—	—	24.0	—	—
10.	*Gambusia affinis*	610	25.0	15.0	—	—	10.0	5.0	45.0	—	—	—	—	—
11.	*Rasbora daniconius*	400	25.0	7.0	12.0	3.0	8.0	—	40.0	—	—	5.0	—	—

Table III—Browsers or bottom feeders

1.	*Barbus carnaticus*	225	14.4	39.2	31.5	—	—	1.1	11.3	0.5	—	—	2.0	—
2.	*B. stigma*	313	15.0	55.0	—	2.0	18.0	8.0	2.0	—	—	—	—	—
3.	*Cirrhina reba*	423	18.0	54.0	6.0	10.0	9.0	—	3.0	—	—	—	—	—
4.	*Etroplus suratensis*	576	28.0	44.0	2.0	5.0	4.0	3.0	2.5	0.5	—	1.0	10.0	—
5.	*Labeo boggut*	100	25.0	56.0	—	—	—	—	—	—	—	—	19.0	—
6.	*L. calbasu*	176	11.0	33.0	28.0	3.0	3.0	6.0	3.0	—	2.0	—	11.0	—
7.	*L. fimbriatus*	610	26.0	38.0	—	—	1.0	4.0	3.0	—	—	—	28.0	—
8.	*L. kontius*	214	21.0	16.0	19.0	—	4.0	3.0	9.0	—	—	6.0	22.0	—
9.	*Lepidocephalus thermalis*	250	25.0	65.0	—	3.0	—	2.0	—	—	—	—	5.0	—
10.	*Nuria danrica*	234	30.0	40.0	—	—	7.0	3.0	12.0	—	—	—	8.0	—
11.	*Ophiocephalus punctatus*	418	—	—	—	—	—	—	25.0	5.0	20.0	30.0	20.0	—
12.	*Pangasius pangasius*	175	—	1.6	10.7	—	—	2.3	18.2	31.8	35.4	—	—	—
13.	*Tilapia mossambica*	433	21.0	52.0	12.0	0.3	5.1	3.4	—	0.1	—	—	6.0	—

Table IV—Vegetable feeders

1.	*Barbus curmuca*	232	10.0	23.0	38.0	6.0	3.0	9.0	5.0	—	—	6.0	—	—
2.	*B. hexagonolepis*	375	7.1	5.3	45.1	1.2	—	2.6	26.1	0.6	7.0	0.2	5.0	—
3.	*Osphronemus goramy*	267	3.0	15.0	60.0	—	—	8.0	7.0	—	—	7.0	—	—

PERCENTAGE COMPOSITION OF THE FOOD GROUPS IN THE GUT CONTENTS OF THE FRESHWATER FISHES OF MADRAS

Table I—Plankton feeders

(1)	Name of fish (2)	Number of specimens examined (3)	Unicellular algae (4)	Filamentous algae (5)	Higher plants (6)	Protozoans (7)	Copepods (8)	Crustaceans (9)	Insects (10)	Fish (11)	Molluscs (12)	Worms (13)	Mud and sand (14)	Amphibians (15)
1.	*Ambassis nama*	210	0.2	—	—	16.4	45.8	16.1	21.3	—	—	—	0.2	—
2.	*A. ranga*	230	0.4	—	—	10.1	46.9	25.7	16.5	—	—	—	0.4	—
3.	*Barbus amphibius*	260	62.0	18.0	—	—	12.0	1.0	5.0	—	—	—	2.0	—
4.	*B. aurelius*	311	32.0	24.0	4.0	6.0	13.0	—	15.0	—	—	—	6.0	—
5.	*B. chola*	250	68.0	12.0	—	—	12.0	4.0	—	—	—	—	4.0	—
6.	*B. dorsalis*	210	37.5	15.0	—	6.0	11.6	8.3	20.0	—	—	1.6	—	—
7.	*B. dubius*	136	29.1	24.1	—	1.0	12.5	2.0	17.2	—	12.1	—	2.0	—
8.	*B. filamentosus*	175	28.0	22.0	—	—	24.0	8.0	10.0	—	—	—	8.0	—
9.	*B. sarana*	150	5.3	8.0	—	16.6	21.6	—	8.6	20.0	16.6	—	3.3	—
10.	*B. sophore*	250	44.0	24.0	—	—	16.0	2.0	10.0	—	—	—	4.0	—
11.	*B. ticto*	270	34.0	25.0	—	—	20.0	3.0	10.0	—	—	—	8.0	—
12.	*B. vittatus*	145	32.0	18.0	—	—	34.0	1.0	8.0	—	—	—	7.0	—
13.	*Catla catla*	1,500	28.0	10.0	30.0	5.0	10.0	10.0	—	—	3.0	—	4.0	—
14.	*Chela clupeoides*	134	4.0	2.0	—	2.0	58.0	16.0	18.0	—	—	—	—	—
15.	*Cirrhina cirrhosa*	360	52.0	19.0	—	8.0	14.0	7.0	—	—	—	—	—	—
16.	*Labeo boga*	110	39.0	22.0	—	8.0	15.0	12.0	—	—	—	—	4.0	—
17.	*Lebistes reticulatus*	440	30.0	15.0	—	5.0	10.0	10.0	27.0	—	—	3.0	—	—
18.	*Macropodus cupanus*	320	35.0	20.0	—	5.0	—	20.0	15.0	—	—	—	5.0	—
19.	*Osteocheilus thomassi*	176	60.0	5.0	—	10.0	20.0	—	—	—	5.0	—	—	—
20.	*Thynnichthys sandkhol*	184	50.0	12.0	—	10.0	18.0	10.0	—	—	—	—	—	—

Table II—Insectivores

(1)	Name of fish (2)	Number of specimens examined (3)	Unicellular algae (4)	Filamentous algae (5)	Higher plants (6)	Protozoans (7)	Copepods (8)	Crustaceans (9)	Insects (10)	Fish (11)	Molluscs (12)	Worms (13)	Mud and sand (14)	Amphibians (15)
1.	*Anabas scandens*	185	—	2.0	13.0	—	—	10.5	40.5	14.0	19.0	—	1.0	—
2.	*Aplocheilus lineatus*	413	22.0	—	—	9.0	11.0	—	58.0	—	—	—	—	—
3.	*Barilius bakeri*	164	5.0	5.0	—	—	5.0	10.0	70.0	—	5.0	—	—	—
4.	*B. bendelisis*	128	8.0	10.0	2.0	1.0	10.0	13.0	46.0	—	8.0	1.0	1.0	—
5.	*Chela argentea*	527	15.0	10.0	—	5.0	12.0	3.0	55.0	—	—	—	—	—
6.	*C. bacaila*	213	3.4	9.2	—	—	—	—	64.6	22.8	—	—	—	—
7.	*C. untrahi*	385	4.0	3.0	—	3.0	22.0	2.0	66.0	—	—	—	—	—
8.	*Danio aequipinnatus*	440	16.6	20.8	8.3	—	8.5	—	45.6	0.2	—	—	—	—
9.	*Etroplus maculatus*	450	6.6	5.6	1.6	2.0	28.2	1.0	31.0	—	—	24.0	—	—
10.	*Gambusia affinis*	610	25.0	15.0	—	—	10.0	5.0	45.0	—	—	—	—	—
11.	*Rasbora daniconius*	400	25.0	7.0	12.0	3.0	8.0	—	40.0	—	—	5.0	—	—

Table III—Browsers or bottom feeders

(1)	Name of fish (2)	Number of specimens examined (3)	Unicellular algae (4)	Filamentous algae (5)	Higher plants (6)	Protozoans (7)	Copepods (8)	Crustaceans (9)	Insects (10)	Fish (11)	Molluscs (12)	Worms (13)	Mud and sand (14)	Amphibians (15)
1.	*Barbus carnaticus*	225	14.4	39.2	31.5	—	—	1.1	11.3	0.5	—	—	2.0	—
2.	*B. stigma*	313	15.0	55.0	—	2.0	18.0	8.0	2.0	—	—	—	—	—
3.	*Cirrhina reba*	423	18.0	54.0	6.0	10.0	9.0	—	3.0	—	—	—	—	—
4.	*Etroplus suratensis*	576	28.0	44.0	2.0	5.0	4.0	3.0	2.5	0.5	—	1.0	10.0	—
5.	*Labeo boggut*	100	25.0	56.0	—	—	—	—	—	—	—	—	19.0	—
6.	*L. calbasu*	176	11.0	33.0	28.0	3.0	3.0	6.0	3.0	—	2.0	—	11.0	—
7.	*L. fimbriatus*	610	26.0	38.0	—	—	1.0	4.0	3.0	—	—	—	28.0	—
8.	*L. kontius*	214	21.0	16.0	19.0	—	4.0	3.0	9.0	—	—	6.0	22.0	—
9.	*Lepidocephalus thermalis*	250	25.0	65.0	—	3.0	—	2.0	—	—	—	—	5.0	—
10.	*Nuria danrica*	234	30.0	40.0	—	—	7.0	3.0	12.0	—	—	—	8.0	—
11.	*Ophiocephalus punctatus*	418	—	—	—	—	—	—	25.0	5.0	20.0	30.0	20.0	—
12.	*Pangasius pangasius*	175	—	1.6	10.7	—	—	2.3	18.2	31.8	35.4	—	—	—
13.	*Tilapia mossambica*	433	21.0	52.0	12.0	0.3	5.1	3.4	—	0.1	—	—	6.0	—

Table IV—Vegetable feeders

(1)	Name of fish (2)	Number of specimens examined (3)	Unicellular algae (4)	Filamentous algae (5)	Higher plants (6)	Protozoans (7)	Copepods (8)	Crustaceans (9)	Insects (10)	Fish (11)	Molluscs (12)	Worms (13)	Mud and sand (14)	Amphibians (15)
1.	*Barbus curmuca*	232	10.0	23.0	38.0	6.0	3.0	9.0	5.0	—	—	6.0	—	—
2.	*B. hexagonolepis*	375	7.1	5.3	45.1	1.2	—	2.6	26.1	0.6	7.0	0.2	5.0	—
3.	*Osphronemus goramy*	267	3.0	15.0	60.0	—	—	8.0	7.0	—	—	7.0	—	—

PERCENTAGE COMPOSITION OF THE FOOD GROUPS IN THE GUT CONTENTS OF THE FRESHWATER FISHES OF MADRAS—(*Contd.*)

(1)	Name of fish (2)	Number of specimens examined (3)	Unicellular algae (4)	Filamentous algae (5)	Higher plants (6)	Protozoans (7)	Copepods (8)	Crustaceans (9)	Insects (10)	Fish (11)	Molluscs (12)	Worms (13)	Mud and sand (14)	Amphibians (15)
	Table V—Column feeders													
1.	*Barbus chrysopoma**	280	2.0	7.1	16.4	1.0	1.4	54.7	6.4	10.0	—	1.0	—	—
	Table VI—Piscivores													
1.	*Callichrous pabda*	187	—	30.0	—	—	2.0	—	—	68.0	—	—	—	—
2.	*C. macrophthalmus*	231	—	—	—	—	—	1.8	28.0	69.0	—	—	1.2	—
3.	*Glossogobius giuris*	311	—	—	2.0	—	—	—	11.0	78.0	9.0	—	—	—
4.	*Gobius biocellatus*	173	—	—	4.1	—	—	36.6	8.3	51.0	—	—	—	—
5.	*Macrones seenghala*	200	—	2.0	—	—	—	23.0	11.0	60.0	2.0	1,0	—	—
6.	*Notopterus notopterus*	267	2.0	8.0	6.0	1.0	—	26.0	16.0	31.0	10.0	—	—	—
7.	*Ophiocephalus marulius*	250	—	—	—	—	—	—	—	55.0	—	5.0	20.0	20.0
8.	*O. striatus*	220	—	—	—	—	—	—	10.0	35.0	—	20.0	5.0	30.0
9.	*Saccobranchus fossilis*	413	—	—	—	5.0	—	16.0	22.0	42.0	15.0	—	—	—
10.	*Silonia silonia*	126	—	1.0	—	—	—	18.0	12.0	47.0	17.0	—	5.0	—
11.	*Wallago attu*	211	—	—	—	—	—	14.0	7.0	78.0	1.0	—	—	—

* *Barbus chrysopoma* is considered a synonym of *Barbus sarana* by some recent authors. The difference in the food analysis of the two mentioned in the table is probably due to the variation in the two habitats from which the samples were drawn.

A Note on *Aeginetia acaulis* (Roxb.) Walp.

BY

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AND

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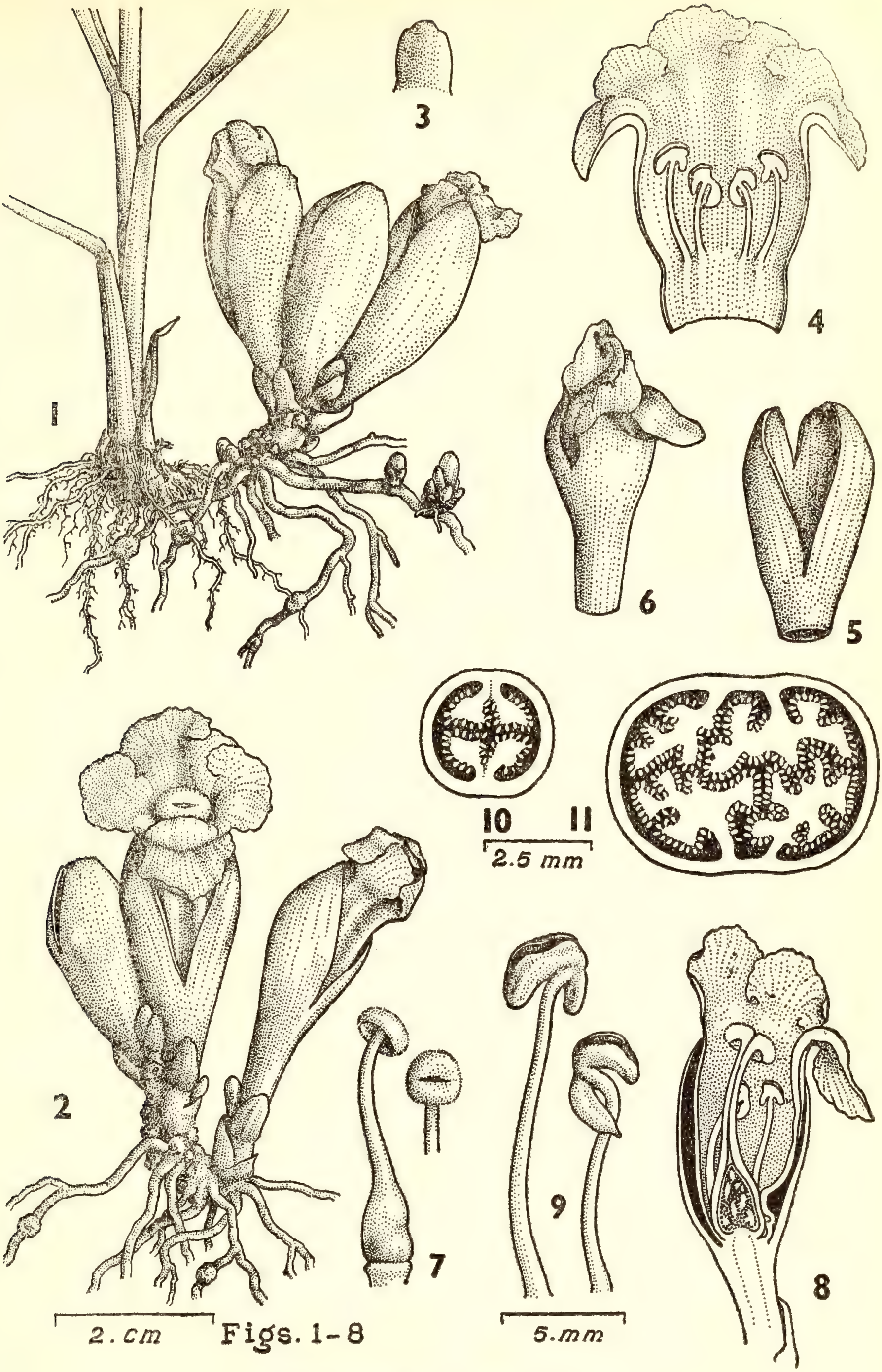
(*With one plate*)

The plant forming the subject of this note was found growing on grassy hill-slopes at Ponmudi in the Western Ghats at an altitude of about 900 metres. It was first collected by the authors in October 1954 and subsequently during September, October, and November in 1955 and 1956. A very large number of plants was examined in the fresh condition; observations made on the same fresh plants showed characters closely resembling those of the imperfectly known *Aeginetia abbreviata* Buch.-Ham. and *Aeg. acaulis* (Roxb.) Walp. According to Beck Mannagetta (1930) the former species has been reported from Rangoon in Burma, Sylhet in East Pakistan, and Manila in the Philippines; but he has not mentioned anything about the distribution of the latter species. In view of the fact that our material combines characters of both the ill-defined species mentioned above, we think it worthwhile to give a comprehensive description of it based on the very ample material at our disposal.

DESCRIPTION

Plants parasitic on the roots of grasses. *Rhizome* very short, simple, up to 8 mm. thick, irregularly cylindrical, light brown and sparsely scaly. *Roots* few to many, wiry, sparsely branched with irregular swellings at the place of contact with the host roots, up to 2 mm. thick and occasionally developing adventitious buds that serve for vegetative propagation. *Inflorescence* solitary and terminal or rarely 2-3 arising from the axils of scale leaves in the shortened rhizome; raceme 1-3-flowered or rarely in radical irregular congested sessile clusters and 4-5-flowered. *Peduncle* creamy white, glabrous, not reaching much above the soil level and up to 6 mm. thick and 2.5 cm. long. *Bracts* 3-8 mm. long, lower ones small sterile, and creamy white, upper ones larger, fertile, and with a violet tinge, ovate or ovate-triangular, imperfectly three-lobed, median lobe larger and obtuse, margin non-ciliate. *Pedicels* always much shorter than the flowers, 2-14 mm. long and light greyish violet in colour. *Flowers* medianly zygomorphic, 1.5-3.8 cm. long. *Calyx* spathaceous, split in front to the base or nearly so, at the back to a quarter to half its length, the lobes unequal (rarely 3-5 subequal lobes); the whole calyx is more or less equal in length to the corolla tube, 1.3-3 cm. long, broader above, narrowing to the base, its inner surface glandular, the outer one greyish violet with a touch of yellow about the middle; the calyx is filled with a viscous fluid. *Corolla* tube more or less as long as the calyx, dull yellow, glabrous, lower side inflated, base contracted, constricted at the insertion of the stamens, afterwards broadened and then expanding into a bilabiate 5-lobed lim; throat golden yellow; lobes bright violet, orbicular-reniform, obscurely crenulate imbricate; the three anterior lobes differ in size, intensity of colour, and texture from the two posterior ones; median anterior lobe larger than the others, deflexed outwards and then downwards and with a comparatively thick prominent bright golden yellow platform near the throat; anterior lateral lobes each with a circular golden yellow mark on the margin adjacent to the odd lobe. *Stamens* 4, inserted at the constricted part of the corolla tube, included, didynamous, filaments glabrous, anther cells divergent, one sterile and one fertile, the sterile cell of the longer stamens much reduced and subconical, that of the shorter stamens as long as or slightly longer than the fertile cell, fleshy, falcate and shortly mucronate, fertile cell of the lateral pairs imperfectly connate along their lateral sides, subreniform and with extrorse longitudinal dehiscence; pollen grains 17-24 μ broad, smooth walled and many of them germinating even before liberation from the anther cells. *Ovary* of 2 carpels, syncarpous, unilocular, placentae parietal, bifurcating, fleshy and solid above, intricately lamellated below, ovules 165-215 μ long, 115-148 μ broad, numerous, anatropous, and arising from the entire surface of the placenta; style glabrous, persistent; stigma large, peltate or rarely subcordate-peltate, densely pubescent, and with a transverse slit in the centre. *Fruit* ovoid, beaked, capsule somewhat fleshy and irregularly dehiscing, dark pulpy placentum much relished by insects and seeds dispersed by them after passage through their alimentary canal; seeds 320-363 μ long and 198-240 μ broad, ovoid, dark brown, and with a hard, stony seed coat; embryo minute and undifferentiated, endosperm oily and filling the seed.



Aeginetia acaulis (Roxb.) Walp.

1. Entire plant attached to the roots of the host plant showing flowers in a radical cluster and roots with adventitious buds. 2. Plant showing flowers in various stages of development and the origin of secondary inflorescence from the rhizome. 3. Bract. 4. Spread open corolla tube showing didynamous stamens. 5. Calyx. 6. Mature fruit showing persistent style, calyx, and part of the corolla tube. 7. Gynoecium showing front and side views of the stigma. 8. Median L.S. of flower. 9. Stamens. 10. T.S. of ovary through upper part. 11. T.S. of ovary through the middle part.

DISCUSSION

According to Hooker (1892), *Aeginetia abbreviata* Buch.-Ham. and *Aeg. acaulis* (Roxb.) Walp. do not differ from *Aeg. pedunculata* Wall. and hence he considers these names as synonyms of the latter species. Beck Mannagetta (1930), however, provisionally recognises those two species as varieties of *Aeg. pedunculata,* viz. *Aeg. pedunculata* Wall. var. *abbreviata* (Buch.-Ham.) and *Aeg. pedunculata* Wall. var. *acaulis* (Roxb.) Walp.

A careful study of the characters of the plant described in this note clearly reveals the fact that it incorporates the characters of both the above mentioned varieties of *Aeg. pedunculata* described by Beck Mannagetta. Hence there is every reason to believe that these two varieties represent one and the same plant described by different authors from scanty materials, collected probably from widely differing localities.

The relationship of the plant under study is obviously with *Aeg. pedunculata* Wall., but clearly differing in the much shorter scape and pedicels, imperfectly three-lobed bracts which are non-ciliate at their margins, smaller flowers, bipartite calyx, bilabiate corolla, smaller pollen grains, deeply lamellose, fleshy, parietal placentas, and pulpy capsular fruit. In *Aeg. pedunculata* the pedicels are 2.5-10.2 cm. long, the bracts 5-17 mm. long, calyx 3.5-6.5 cm. long, pollen grains 25-31 μ broad; in our specimens the pedicels are 5-15 mm. long, the bracts 3-8 mm. long, calyx 1.5-3 cm. long, and pollen grains 17-24 μ broad. With such marked differences the inclusion of this plant along with *Aeg. pedunculata* is not only anomalous, but also makes the so-called species a very complex mixture of characters: hence it is only right that the plant described in this note should be raised to specific rank and kept distinct from *Aeg. pedunculata* Wall.

Now the question arises as to what its name should be. Of the two names previously used, viz. *Aeginetia acaulis* (Roxb.) Walp. and *Aeg. abbreviata* Buch.-Ham., the latter is *nomen nudum* in the sense of the Rules; this means that the name is illegitimate. It was however, legitimised later by Bentham in 1835. But the other name *Aeg. acaulis* (Roxb.) Walp. is based on Roxburgh's name of 1832; therefore, in accordance with the Rule of Priority, Walpers's name is the only legitimate one.

The correct name of the species described in this note and its synonymy are as follows:

Aeginetia acaulis (Roxb.) Walp. Repert 3: 481, 1844-1845, *char. emend.*

Syn. *Orobanche acaulis* Roxb. in Fl. Ind. 3: 28, 1832; et Pl. Corom. t. 292, 1819.

Aeg. pedunculata Wall. var. *acaulis* (Walp.) Beck Mannagetta in Pflanzenreich 96: 21, 1930.
Aeg. abbreviata Buch.-Ham. in Wall. Catal. n. 3865, *nom. nud.* 1831; Bentham in Scroph. Ind. 55, 1835.
Aeg. pedunculata Wall var. *abbreviata* (Buch.-Ham.) Beck Mannagetta in Pflanzenreich 96: 20, 1930.

By the occasional presence of a distinctly five-lobed calyx and bilabiate corolla *Aeg. acaulis* also possibly exhibits a certain amount of relationship with the genus *Christisonia.*

SUMMARY

Aeginetia acaulis (Roxb.) Walp. which is closely allied to *Aeg. pedunculata* Wall. is considered to be a distinct species. A detailed description of the species from a study of living specimens is given.

ACKNOWLEDGEMENTS

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The Flora of Ajmer (Rajasthan)

I. A LIST OF TREES, SHRUBS, AND WOODY CLIMBERS

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INTRODUCTION

Ajmer is situated almost in the centre of Rajasthan. The city stands at the foot of Taragarh Hill on a plateau, about 1580 ft. above mean sea-level. The town covers the entire valley between Taragarh and Madar Hills, which are the schists of the enormously stretched Aravali Range.

The climate of Ajmer is somewhat different from the surrounding arid regions of Rajasthan. Ajmer is at its best during the rains when the surrounding hills are draped in green. The famous lakes, Pushkar, Foysagar, and Anasagar, are then full of water. The waterfalls and streams add to the beauty of the mountain scenery.

The forest vegetation is of the deciduous type. It is in the form of scrub jungles, localised at the foot or on the hills. The forests of Nag Pahar, Rajgarh, and Todgarh are fairly large and become luxuriant during the rainy season. Todgarh forests have no scrubby appearance, large trees being common.

The plants, to name some of them, *Anogeissus pendula, Prosopis spicigera, Acacia* spp., *Boswellia serrata, Commiphora mukul, Grewia* spp., *Rhus mysorensis, Dichrostachys cinerea, Mimosa hamata, Bauhinia racemosa, Wrightia tinctoria, Flueggea leucopyrus,* and *Sterculia urens,* mainly constitute the protected vegetation of this area.

In the plain, *Azadirachta indica* is the most abundant tree, though *Ficus bengalensis, Ficus religiosa, Salvadora persica, Dalbergia sissoo, Ailanthus excelsa, Tamarindus indica, Prosopis spicigera, Pithecolobium dulce, Zizyphus mauritiana, Cordia rothii, Cordia myxa,* and *Albizzia lebbeck* are not uncommon.

Nevertheless, some of the hillocks are covered almost entirely with *Acacia senegal* and *Acacia leucophloea,* while many isolated hillocks and the sun-baked slopes of some are almost naked or inhabited by scattered clumps of *Euphorbia nivulia.* During the rains also, these areas remain poor in vegetation. On the contrary, in the forests confined to the western slopes or in the crevices of the hills, thick vegetation is developed due to the abundance of short-lived herbaceous plants.

I. ANGIOSPERMS

ANNONACEAE

1. **Polyalthia longifolia** Benth. & Hook f. A handsome avenue tree.

2. **Annona squamosa** Linn. Cultivated.

MENISPERMACEAE

3. **Tinospora cordifolia** Miers A soft-wooded climber. Also cultivated and used medicinally.

4. **Tiliacora racemosa** Colebr. An extensive climber. Cultivated.

5. **Cocculus hirsutus** (Linn.) Diels. (*C. villosus* DC.) A common climber.

6. **Cocculus cebatha** DC. A common climber.

CAPPARIDACEAE

7. **Maerua arenaria** (DC.) Hk. f. & Thoms. A large climber.

8. **Crataeva nurvala** Buch.-Ham. (*C. religiosa* Forst. f.) A handsome tree. Cultivated.

9. **Capparis zeylanica** Linn. (*C. horrida* Linn.f.) A shrubby climber.

10. **Capparis decidua** (Forsk.) Pax. (*C. aphylla* Roth.) A much branched spinous shrub, frequently a small tree.

11. **Capparis sepiaria** Linn. An uncommon shrub in hilly and shaded areas.

12. **Capparis spinosa** Linn. A shrub or a small tree.

TAMARICACEAE

13. **Tamarix dioica** Roxb. Small trees, frequent on saline ground and at the bank of reservoirs. Also planted along Pushkar and Foysagar roads.

14. **Tamarix gallica** Linn. Small trees, in the neighbourhood of villages.

15. **Tamarix ericoides** Rottl. A shrub with vertical branches, found on the beds of Luni river.

MALVACEAE

16. **Abutilon indicum** G. Don A woody shrub; common in moist and shaded rocky areas.

17. **Hibiscus rosa-sinensis** Linn. An ornamental shrub. Cultivated.

18. **Achania leschenaultii** Sw. Large shrubs; cultivated. Flowers as in *Hibiscus rosa-sinensis* but pendulous and half-opened.

BOMBACACEAE

19. **Adansonia digitata** Linn. Large trees. Only two plants with enormous trunks are seen near the Mangaliawas reservoir.

20. **Salmalia malabarica** Schott (*Bombax malabaricum* DC.) Large trees ; occasionally planted along roads.

STERCULIACEAE

21. **Sterculia urens** Roxb. Small to moderate-sized trees with low branching. Confined to hills.

22. **Melhania hamiltoniana** Wall. A small and rare shrub ; usually occurring in shady places.

23. **Guazuma tomentosa** H. B. & Kunth. Small roadside trees. Not common.

TILIACEAE

24. **Grewia populifolia** Vahl A much branched small shrub. Very common in scrub-jungles.

25. **Grewia salvifolia** Heyne Large woody shrubs. Abundant on hills.

26. **Grewia asiatica** Linn. Large shrubs or small trees with drooping branches. Cultivated.

27. **Grewia flavescens** Juss. Large straggling shrubs with blackish quadrangular stems. Very common in scrub-jungles.

ZYGOPHYLLACEAE

28. **Guaiacum officinale** Linn. Rare. Only two small trees are growing in a private bungalow.

29. **Balanites roxburghii** Planch. (*B. aegyptiaca* Del.) Thorny shrubs to under-trees. Common at the foothills and in rocky areas. Also planted along roads.

GERANIACEAE

30. **Averrhoa carambola** Linn. A medium sized tree. Cultivated.

RUTACEAE

31. **Murraya koenigii** (Linn.) Spreng. Cultivated.

32. **Limonia acidissima** Linn. Small spinous trees. Confined to forests.

33. **Citrus medica** Linn. Various varieties are cultivated.

34. **Feronia limonia** (Linn.) Swingle. (*F. elephantum* Correa) Large trees, usually on roadsides.

35. **Aegle marmelos** Correa. Moderate-sized trees. Also cultivated.

SIMARUBACEAE

36. **Ailanthus excelsa** Roxb. Large trees, attaining maximum size in sandy areas. Very common around Pushkar. Also commonly planted.

BURSERACEAE

37. **Boswellia serrata** Roxb. Small trees with peeled-off thin ashy or greenish flakes of bark. Sometimes this is the only dominant tree on the hill-tops.

38. **Commiphora mukul** Engl. (*Balsamodendron mukul* Hook.) A stunted shrub or a small tree. Also cultivated for its resin.

MELIACEAE

39. **Azadirachta indica** Juss. (*Melia azadirachta* Linn.) Very common on the plain.

40. **Cedrela toona** Roxb. (*Toona ciliata* Roem.) Cultivated.

CELASTRACEAE

41. **Gymnosporia montana** Benth. [*G. spinosa* (Forsk.) Fiori. and *Celastrus senegalensis* Lamk.] Spinous shrubs or small trees. Abundant on slopes and at the foot-hills. Well adapted to sandy areas.

42. **Celastrus paniculata** Willd. A large, uncommon woody climber. Confined to forests.

43. **Elaeodendron glaucum** Pers. Cultivated.

RHAMNACEAE

44. **Zizyphus mauritiana** Lamk. (*Z. jujuba* Lamk.) Large shrubs or small trees. Common on the plain.

45. **Zizyphus xylopyra** Willd. A common large straggling shrub or small tree.

46. **Zizyphus nummularia** Wt. & Arn. (*Z. rotundifolia* Lamk.) A dense prickly shrub ; common on plain as well as hills.

SAPINDACEAE

47. **Sapindus emarginata** Vahl (*S. trifoliatus* Linn.) Moderate-sized trees, occasionally along roads.

48. **Dodonaea viscosa** Jacq. Cultivated as a hedge.

ANACARDIACEAE

49. **Rhus mysorensis** Heyne Large shrubs. Very common in scrub-jungles. Fruits edible.

50. **Mangifera indica** Linn. Frequent in country-side. Many trees are growing in and around Taragarh.

MORINGACEAE

51. **Moringa oleifera** Lamk. (*M. pterygosperma* Gaertn.) Medium-sized or large trees. Frequent on plain and low hills.

PAPILIONACEAE

52. **Abrus precatorius** Linn. A climber, usually on *Grewia* spp.

53. **Butea monosperma** (Lamk.) Taub. (*B. frondosa* Roxb.) Moderate-sized trees with deformed stems, grow at the foothills and in sandy areas.

54. **Dalbergia sissoo** Roxb. Large trees, planted along roads, outside the city.

55. **Pongamia pinnata** Pierre. (*P. glabra* Vent.) Medium-sized trees, planted along roads.

56. **Sophora secundiflora** Lag. Cultivated.

CAESALPINIACEAE

57. **Caesalpinia sepiaria** Roxb. A large rambling prickly shrub. Introduced from Mount Abu.

58. **Caesalpinia pulcherrima** Swartz. (*Poinciana pulcherrima* Linn.) Large shrubs, cultivated.

59. **Delonix elata** Gamble. (*Poinciana elata* Linn.) Moderate-sized trees, cultivated.

60. **Delonix regia** Raf. (*Poinciana regia* Bojer). Moderate-sized, fast growing soft-wooded trees. Commonly cultivated.

61. **Parkinsonia aculeata** Linn. A small spiny shrub or small tree ; cultivated and naturalised.

62. **Cassia fistula** Linn. Small trees ; cultivated.

63. **Cassia auriculata** Linn. Small glabrous shrubs, on waste land.

64. **Cassia siamea** Lamk. Moderate-sized trees along roads. In flower throughout the year.

65. **Hardwickia binata** Roxb. Moderate-sized trees, cultivated.

66. **Tamarindus indica** Linn. Large trees. Common on the plain.

67. **Bauhinia racemosa** Lamk. Small trees, usually with deformed stems. Common in forests.

68. **Bauhinia malabarica** Roxb. Small trees ; cultivated.

69. **Bauhinia retusa** Ham. Moderate-sized trees. Confined to forests.

70. **Bauhinia purpurea** Linn. Small trees ; frequent in the forests.

MIMOSACEAE

71. **Prosopis spicigera** Linn. A small tree, common on the plain.

72. **Prosopis juliflora** DC. Large evergreen shrubs or small trees with drooping branches. A very successful plant for the arid areas. Various ' forms ' have been introduced under the afforestation scheme.

73. **Prosopis glandulosa** Torr. Introduced under the afforestation scheme.

74. **Dichrostachys cinerea** Wt. et Arn. A compactly branched shrub or a dwarf tree. Common in hills and rocky areas. Beautiful double-coloured spikes.

75. **Leucaena glauca** Benth. Large shrubs ; cultivated.

76. **Mimosa rubicaulis** Lamk. A straggling shrub ; restricted to forests.

77. **Mimosa hamata** Willd. A much branched low shrub. Common in scrub jungle.

78. **Acacia farnesiana** Willd. A shrub ; introduced in desert areas.

79. **Acacia arabica** Willd. Moderate-sized trees ; common in country-side.

80. **Acacia jacquemontii** Benth. A shrub ; introduced for afforestation in desert areas.

81. **Acacia leucophloea** Willd. Small trees, found abundantly on low hills.

82. **Acacia catechu** Willd. Small trees ; common in Todgarh Forests.

83. **Acacia senegal** Willd. (*A. rupestris* Stocks). Small trees, found abundantly on low hills.

84. **Albizzia lebbeck** Benth. Large trees, common along roads.

85. **Albizzia odoratissima** Benth. A rare tree, confined to forests.

86. **Pithecolobium dulce** Benth. Moderate-sized to large trees ; strongly armed. Largely cultivated near human inhabited areas.

COMBRETACEAE

87. **Terminalia belerica** Roxb. Cultivated.

88. **Anogeissus pendula** Edgew. Moderate-sized trees, the main constituent of the forests.

89. **Anogeissus latifolia** Wall. A moderate-sized tree ; common in forests.

90. **Anogeissus acuminata** Wall. A small tree, confined to forests.

91. **Quisqualis indica** Linn. Largely cultivated as a wall-climber for its pendulous showy flowers.

MYRTACEAE

92. **Psidium guayava** Linn. Extensively cultivated for its edible fruits.

93. **Syzygium cumini** (Linn.) Skeels. (*Eugenia jambolana* Lamk.) Frequently planted in the country-side.

94. **Eucalyptus drepanophylla** F. Muell. Cultivated.

95. **Eucalyptus microtheca** F. Muell. Cultivated.

96. **Eucalyptus rostrata** Schl. Cultivated.

97. **Callistemon linearis** DC. Cultivated as an ornamental plant.

LYTHRACEAE

98. **Lawsonia inermis** Linn. (*L. alba* Lamk.) Commonly cultivated as a hedge plant.

99. **Lagerstroemia indica** Linn. Small ornamental shrubs.

PUNICACEAE

100. **Punica granatum** Linn. Cultivated for edible fruits.

CARICACEAE

101. **Carica papaya** Linn. Cultivated for its fruits ; common in Pushkar area.

RUBIACEAE

102. **Ixora parviflora** Vahl. Small evergreen trees ; cultivated.

103. **Anthocephalus cadamba** Miq. Large trees. Also cultivated.

104. **Hamelia patens** Jac. An ornamental shrub.

THEOPHRASTACEAE

105. **Jacquinia ruscifolia** Spreng. A spinous shrub with attractive flowers ; cultivated.

SAPOTACEAE

106. **Mimusops elengi** Linn. Small trees. Cultivated for sweet-scented flowers.

107. **Mimusops hexandra** Roxb. Cultivated.

EBENACEAE

108. **Diospyros embryopteris** Pers. Cultivated.

OLEACEAE

109. **Nyctanthes arbor-tristis** Linn. Large shrubs with quadrangular drooping branches. Cultivated.

SALVADORACEAE

110. **Salvadora oleoides** Decne. Large shrubs or small trees. Not frequent.

111. **Salvadora persica** Linn. Moderate-sized trees, usually with deformed trunks. Common on the plain.

APOCYNACEAE

112. **Carissa congesta** Wight (*C. carandas* auct., non Linn.) Large shrubs with paired stout spines ; cultivated, and naturalised.

113. **Plumeria acutifolia** Poir. The 'Pagoda tree', a laticiferous xerophyte ; cultivated.

114. **Wrightia tomentosa** Roem. Moderate-sized trees. Frequent in forests.

115. **Wrightia tinctoria** R. Br. Small trees ; common on the shaded hills.

116. **Nerium indicum** Mill. Large evergreen shrubs ; cultivated.

117. **Thevetia neriifolia** Juss. Small ornamental trees with yellow flowers. Cultivated.

ASCLEPIADACEAE

118. **Cryptostegia grandiflora** R. Br. A scrambling evergreen shrub or an extensive climber. Very common on waste land.

119. **Calotropis gigantea** R. Br. Large shrubs ; common on the plain.

120. **Calotropis procera** R. Br. Small shrubs ; very common on the plain.

121. **Leptadenia pyrotechnica** (Forsk.) Decne. (*L. spartium* Wight) A much branched dense shrub on sandy soil and hilly areas.

LOGANIACEAE

122. **Buddleia asiatica** Lour. Cultivated.

BORAGINACEAE

123. **Cordia rothii** Roem. Small trees ; commonly seen near inhabited areas. Fruits edible.

124. **Cordia crenata** Del. Small trees ; some plants may climb over other trees with their twisted stems. Fruits edible.

125. **Cordia vestita** Hk.f. Moderate-sized trees usually with deformed trunks. Less common. Fruits edible.

126. **Cordia dichotoma** Forst.f. (*C. myxa* Linn.) Medium-sized trees mostly with deformed trunks ; common on the plain.

127. **Cordia macleodii** Hk.f. Small or medium-sized trees. Frequently seen on the plain.

128. **Ehretia laevis** Roxb. Small trees. Very frequent on the plain.

129. **Ehretia aspera** Roxb. Small trees usually with deformed trunks. Noticed only few plants on the plain. Duthie (1903) writes of it as a shrub.

CONVOLVULACEAE

130. **Rivea hypocrateriformis** Chois. A common climber towards country-side, usually over *Euphorbia nivulia* hedges around cultivated fields.

131. **Argyreia speciosa** Sweet An extensive climber. Cultivated.

SOLANACEAE

132. **Lycium europaeum** Linn. Small shrubs. Cultivated as a hedge plant around fields.

133. **Cestrum nocturnum** Linn. Cultivated.

134. **Cestrum diurnum** Linn. Cultivated.

BIGNONIACEAE

135. **Millingtonia hortensis** Linn. Very tall tree. Flowers only in winter.

136. **Tecoma stans** Juss. Small shrubs : cultivated as a hedge plant. Sometimes an isolated plant may attain the size of a small tree.

137. **Tecomella undulata** Seem. A small tree with showy flowers.

138. **Heterophragma adenophyllum** Seem. Cultivated.

139. **Kigelia pinnata** DC. Moderate-sized trees ; planted along roads.

140. **Jacaranda mimosaefolia** D.Don (*J. ovalifolia* R.Br.) Moderate-sized trees. Cultivated in gardens and along roads.

ACANTHACEAE

141. **Barleria prionitis** Linn. A spinous shrub with yellow flowers. Very common in shaded rocky tracts,

VERBENACEAE

142. **Lantana indica** Roxb. Small shrubs ; frequent in rocky areas.

143. **Lantana camara** Linn. Cultivated in gardens or as a hedge plant.

144. **Gmelina arborea** Linn. Small trees ; planted along roads.

145. **Vitex negundo** Linn. A large shrub or an under-tree. Occasionally planted in sandy areas under the afforestation scheme. Also cultivated.

146. **Clerodendrum inerme** Gaertn. Cultivated in contact with wall.

147. **Clerodendrum phlomoidis** Linn.f. Small trees with deformed stems.

148. **Citharexylum subserratum** Swartz. Small trees with drooping branches. Cultivated.

149. **Duranta repens** Linn. (*D. plumieri* Jacq.) Cultivated as a hedge plant.

NYCTAGINACEAE

150. **Bougainvillea spectabilis** Willd. A climber. Various ornamental varieties being grown.

POLYGONACEAE

151. **Antigonon leptopus** Hook. & Arn. Cultivated as an ornamental climber.

PROTEACEAE

152. **Grevillea robusta** A.Cunn. Tall trees with beautiful flowers. Cultivated.

SANTALACEAE

153. **Santalum album** Linn. Cultivated.

EUPHORBIACEAE

154. **Euphorbia nivulia** Buch.-Ham. Most abundant on sparsely covered hills. Commonly used for hedging the cultivated fields.

155. **Emblica officinalis** Gaertn. Cultivated ; also naturalised.

156. **Securinegea leucopyrus** (Willd.) Muell. (*Flueggea leucopyrus* Willd.) Stiff shrubs ; common in hills.

157. **Jatropha curcas** Linn. An under-tree ; cultivated.

158. **Jatropha gossypifolia** Linn. Cultivated.

159. **Ricinus communis** Linn. Frequently cultivated near fields.

ULMACEAE

160. **Holoptelea integrifolia** Planch. Moderate-or large-sized trees. Frequent along roads.

MORACEAE

161. **Morus alba** Linn. Cultivated for its edible fruits.

162. **Morus serrata** Roxb. Cultivated near human habitations.

163. **Ficus bengalensis** Linn. Common on plain.

164. **Ficus religiosa** Linn. Abundant on the plain.

165. **Ficus glomerata** Roxb. Frequently planted along roads.

166. **Ficus infectoria** Roxb. Cultivated.

167. **Ficus rumphii** Bl. Tall trees, found on the plain.

168. **Ficus palmata** Forsk. Cultivated.

CASUARINACEAE

169. **Casuarina equisetifolia** Linn. Trees, cultivated.

PALMACEAE

170. **Phoenix sylvestris** Roxb. Very common towards country-side.

II. GYMNOSPERMS

CYCADACEAE

171. **Cycas revoluta** Thunb. Cultivated.

172. **Cycas circinalis** Roxb. Cultivated.

CONIFERAE

173. **Pinus longifolia** Roxb. Cultivated.

174. **Thuja orientalis** Linn. Cultivated.

GNETACEAE

175. **Ephedra foliata** Boiss. A dioecious climber in the sandy areas, over *Euphorbia nivulia* and other trees.

ACKNOWLEDGEMENTS

I am thankful to Professor B. Tiagi for guidance, and to Principal Bhim Sen for research facilities. I am also indebted to Shri M. B. Raizada for herbarium facilities during my stay at the Forest Research Institute, Dehra Dun.

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Obituary

A. St. J. MacDONALD

Arthur St. John MacDonald was born in Multan, Punjab, on 8th November 1898. He was educated mainly at St. Joseph's College, Naini Tal, and in 1917 joined an indigo concern in Champaran, Bihar. Early in 1918 he received a temporary commission in the Indian Army and served for a short period in Mesopotamia, and later in 1919 in the Frontier War. On demobilisation he joined the firm of Messrs. Begg, Sutherland and Co. at their Purtabpore Sugar Estates. About 1925 he went to Burma to join the firm of Messrs. Finlay Fleming and Co. where he was employed in the Shan States in pioneering work clearing jungles for the cultivation of sugarcane. During his residence in Burma he was able to develop his extraordinary knowledge of nature study, and indulge in his passion for shooting and fishing. Those were fruitful years for Arthur MacDonald from a naturalist's point of view as it was during that period that his love of jungle life and his powers of observation became so highly developed. He could be compared in many respects with the late Jim Corbet as regards his vast knowledge of the ways of wild life in the jungle. When he left Burma after several years residence there, he was for a period at Belsund Sugar Factory, Bihar, before joining Begg, Sutherland and Co. for the second time, leaving them to become manager of a zamindary in Basti District, U.P., near the Nepal border, where he was able to indulge in his hobbies of nature study and breeding gun dogs. He served with distinction in the Second World War and he was holding the rank of Lt.-Colonel when he left the army at the end of the War.

Arthur MacDonald rejoined Begg, Sutherland and Co. for the third time in 1948, and during his holidays, he spent most of his time fishing and shooting in the jungles near the Himalayan foothills, also in the Kumaon Hills and Kashmir. Just before his tragic death on 6th December 1956 he had indicated to his friends his intention of retiring to South Africa where his three brothers and son are now in residence.

Among Arthur's many gifts was his flair for writing extraordinarily interesting articles on shooting, fising, and jungle life. His descriptive powers combined with his dramatic sense made him a welcome contributor to many periodicals both in India and abroad.

He was a frequent contributor to the *Journal of the Bombay Natural History Society* chiefly on shooting and fishing subjects. His long serial on mahseer fishing was subsequently published by the Society in book form under the title of CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA, and is very popular with anglers in India.

J. M. BANNERMAN

Reviews

1. A PRACTICAL GUIDE TO PLANT SOCIOLOGY. By F. R. Bharucha and W. C. De Leeuw. Pp. viii+46 (21.5×14 cm.). Bombay, 1957. Orient Longmans Private Limited. Price Rs. 5.

As the authors have observed in the preface of the book, the subject of Plant Ecology 'has not progressed much in the East' There are very few books which have useful practical guidance for the study of tropical Plant Ecology, and the publication of this book from that point of view is most welcome. Both the authors, the publishers, and the University of Bombay deserve our compliments for their joint efforts for this publication. The style of the book is lucid and the various practical directions and terms are clearly stated and illustrated by examples. It is printed on very good paper and the binding, get-up, and printing are of good quality.

Chapter I deals with Quadrat Method and is followed by a discussion in Ch. II of Analytical and Synthetic Characters. Ch. III describes the habitat and life-forms of plants. This is followed in Ch. IV by an interesting account of Genetical Sociology and Chronology or Successional Phenomena. Ch. V deals with Nomenclature in Plant Ecology with examples. Ch. VI gives useful information on Vegetation Cartography, and Ch. VII brings out the Importance of Phytosociology with interesting examples. Notes on Phytosociological Nomenclature and Bibliography are appended to the end. Suitable space is also left for notes on the last pages. This book will definitely fill a void felt for a very long time by students of Indian Ecology.

The book embodies only one of the various systems of practical plant ecology, that of the Zurich-Montpellier School of Plant Sociology mostly based on and followed in the study of European vegetation. Again, it comprises only the qualitative method of analysis of vegetation (probably due to the manifold preoccupations of the authors). In spite of these limitations, there is little doubt that this publication will be found useful by the students of plant ecology in India, especially on account of the paucity of similar literature on the subject. It is to be desired that by and by further publications on similar lines, giving also the detailed and quantitative methods of analysis of vegetation, other systems of study of tropical plant ecology, and their suitable modifications, will see the light of the day by the same authors or others, and that studies made in India and other tropical countries will contribute towards evolving a satisfactory and useful system for the study of practical Plant Ecology.

P. V. BOLE

2. VOICES OF THE WILD. By Eric Simms. Pp. 230 (8$\frac{3}{4}$″×5$\frac{3}{4}$″). With 15 black-and-white plates. Putnam, 42 Great Russell Street, London, 1957. Price 21*s*. net.

It is evident to any person attempting to record bird or animal calls that this is not at all an easy matter. What one person may write down as 'tit-tit-too-too' and feel quite happy about may be, and usually is, completely unintelligible to another who is not already familiar with the call.

Just as a few pictures convey far more to the uninitiated than many pages of description, so mechanical recordings seem to be the only means of conveying an adequate idea of the calls of an unfamiliar bird or other animal.

Many years ago Nicholson and Koch produced a series of gramophone records of the calls of several species of English birds. Further efforts in England have been greatly accelerated by the development of suitable apparatus during and since the war, and portable tape-recorders, parabolic reflectors, and walkie-talkies were all brought into service by the author. The book is an interesting account of his experiences and the various techniques he employed while in charge of natural history recordings for the British Broadcasting Corporation. In the course of this work he travelled over 40,000 miles and often had to remain awake throughout the night. But his efforts over a comparatively short period have enabled him to record, among other voices of the wild, a series of no less than twelve different calls of the nocturnal badger which on paper can mainly be described as threat, bark, wicker, yarl, yelp, yell, etc.

There are some excellent bird photographs by Eric Hosking and others, and the book opens up great possibilities for similar work in India.

H.A.

3. THE HAWFINCH. By Guy Mountfort. A New Naturalist Special Volume. Pp. 176, 18 photographs, 32 drawings and maps. Collins, London, 1957. Price 18*s*. net.

Bird behaviour is a field in which amateur and expert have always worked well together. The amateur brings to the subject a freshness of approach and freedom from technical jargon which, when combined with an understanding of the principles involved, can make a very valuable contribution to the sum total of our knowledge. Mr. Mountfort represents the amateur at his best, that is if we use the term to mean a person not a scientist by training or profession. He is the Honorary Secretary of the British Ornithologists' Union, and this monograph is the result of years of patient observation of his special love—the Hawfinch.

The Hawfinch is notoriously shy. 'When a mixed flock . . . is feeding beneath trees. . . it is invariably a Hawfinch which first sounds the alarm. The small finches accept the warning without question . . . The Hawfinches spring from the ground almost vertically in complete silence and disappear like rockets into the tops of the trees'. Both text and photographs (including one delightful one of nestlings like a 'large misty-white powderpuff' in the nest) are therefore a considerable achievement.

Undoubtedly the most interesting part of the book is the description of flock behaviour and its gradual transition to courtship behaviour. Males dominate the females in winter but positions are progressively reversed in spring and summer. The males mature sexually earlier than the females, so the difficult task of initiating courtship falls to them. The conflict between opposing sexual and fleeing drives expresses itself in typical courtship actions—the side to side mincing walk, the penguin walk, the deep bow. And here we have to thank Mr. Keith Shackleton for line drawings of these attitudes reconstructed from Mr. Mountfort's rough sketches. The sequence ends in a touching of outstretched beaks followed by a wild zigzagging flight between the trees. Hawfinches are often killed by collision with objects during this stage of courtship.

It is difficult to give an adequate impression of the scope of this study, which ranges from geographical distribution to the mechanics of kernel crushing by the Hawfinch's massive beak. So I shall confine myself to quoting my favourite Hawfinch story, told by Colonel R. Meinertzhagen. A female Hawfinch left her family of four perched on a twig and when one tried to follow her she immediately turned and caught it by the tail, pulled it down to the ground and gave it a good peck, then escorted it back to the others. The offence was not repeated!

Indian workers have extremely promising opportunities for work of this nature. Research in many branches of science is held back by lack of funds, but here the main requirements are time and boundless enthusiasm—and good library facilities. To interpret their observations satisfactorily workers must be acquainted with recent literature on the subject. Is it too much to hope that in the near future there will be built up in India a good Behaviour library?

R. R.

4. A GENERAL TEXTBOOK OF ENTOMOLOGY. By A.D. Imms. 9th Edition. Entirely revised by O.W. Richards and R. G. Davis. Pp. x+886. 1957. Methuen & Co. Ltd., 36 Essex Street, Strand, London W. C. 2. Price 75*s*.

Entomology is well provided with textbooks dealing with its various branches, but few could compare with the tremendous popularity A GENERAL TEXTBOOK OF ENTOMOLOGY by A. D. Imms has enjoyed since it was first published in 1925. For academic work in this country and elsewhere this has been a standard reference book on the subject and has been admirably fulfilling its objectives. The last revised and enlarged edition appeared in 1934, and since then it was reprinted five times, the last being in 1951. However, entomology has not remained static during this period. Recent researches, especially in insect physiology and embryology, have opened up new vistas and at the same time have added much to our knowledge and understanding of insect life. In the light of these advances, the publication of a revised and enlarged edition of this well-known book is indeed welcome.

The new edition incorporates numerous changes, all for the better. Every branch of the vast subject is treated by the revisers with great care and knowledge, and the expansion in the text is based on careful revision. Fifty-one new text figures are added bringing the total number to 609. The citing of references in full at the end of each chapter is a definite improvement over the earlier editions. An 'Addenda to References' precedes an exhaustive fifty-three-page index given in three columns to the page, which also includes names of authors, and generic names with their synonyms indicated by cross reference.

The inter-relationships of the major Arthropod groups have received much attention in recent years and the book opens with an appropriate introductory chapter in which the authors consider a Myriapodan ancestary of Insecta, as strongly evidenced from anatomical and embryological data, to be the most plausible one. It is difficult to select any particular portion of the book for special comment. The first part deals with the anatomy and physiology of insects and, in keeping with the progress achieved in this field during the last two decades, all the sixteen chapters under this section have been completely revised and brought up to date. In doing so, the authors have systematically covered the literature up to 1952, and selected references published since then.

The second part—Development and Metamorphosis—has two chapters, one on embryology and the other on post-embryonic development.

Insect taxonomy has undergone profound changes since the founding of a modern system proposed by F. Brauer in 1885. Twenty-nine orders of Insecta are now recognised, and a critical account of these is given in the third part which occupies about two-thirds the bulk of the book. As the revisers have pointed out in the preface, revisions of insect groups on a world basis are very few and regional revisions, although helpful to a certain extent, are a handicap in that a 'system which seems to work for Europe or North America is often inapplicable to the fauna of Australia or the Orient without undertaking a major piece of original research'. Further, limitations of space and the scope of the book appear to have been the main cause for the non-inclusion of all the families and other divisions of major groups so far proposed. Despite these difficulties, the present revisers have adopted a system which appears to be more acceptable and easily understandable even by students specialising in entomology who undoubtedly will be the most frequent users of this book. The excellent keys provided for the identification of the suborders, superfamilies, and families add considerably to its value as a reference work for both students and research workers.

One gratifying feature is the many references in this edition as in the previous ones to Indian examples. This can be well understood by the universality of the book and the close ties the late Dr. Imms had with the development of entomological research in India. Only a few papers pertaining to entomology published after 1934 in Indian journals and periodicals find mention in the bibliographical section following each chapter. Evidently, as well over 4,000 papers and books on entomology are now appearing in print each year, the inclusion of most of these will once again be beyond the scope of this book. Indeed, to synthesise and interpret the relevant data on 'General Entomology' from this voluminous literature as lucidly as has been done by the revisers Prof. O. W. Richards and Mr. R. G. Davis is no mean achievement. Much credit is also due to the late Dr. A. D. Imms, who by this scholarly work has given a grounding to many generations of students in the various aspects of the study of the largest animal group in the world.

Suffice it to say that there is hardly any other book of comparable scope and comprehensiveness on the subject, and though the price is on the high side this book is strongly recommended for every library.

E. G. S.

5. THE MOLLUSCA OF KRUSADAI ISLAND. II. SCAPHOPODA, PELECYPODA AND CEPHALOPODA. By S. Thomas Satyamurti. *Bulletin of the Madras Government Museum* (New Series), Natural History Section, Volume I, No. 2, pt. 7, pp. i-iv+202 (11″×8¾″) with 30 plates. December 1956. Price Rs. 9.37 nP.

The littoral fauna of the Indian coast abounds in Mollusca but no one place is so rich in reef-dwelling species as Krusadai and the adjacent islands in the Gulf of Manaar. To teachers and students of biology from various parts of India this area has been a veritable training ground for field work in marine biology, and hence any treatise on the animals of Krusadai is bound to evince considerable interest.

The Amphineura and Gastropoda of Krusadai Island were reported on by Satyamurti in 1952 (*Bull. Madras Govt. Mus.* (*N.S.*), I (2), pt. 6, pp. i-xxxiv+267). That and the present report are based on the shell collections in the Natural History Section, Madras Government Museum, made in the recent past by F. H. Gravely, J. Hornell, M. D. Crichton, and many others. The number of molluscan species recorded from Krusadai is about 450, but the author rightly contends that more intensive collecting would greatly augment the list.

The occurrence of many widely distributed and variable species has had its share in complicating molluscan taxonomy. Foreseeing difficulties, the author has adopted in the main the classification given by Thiel in his work, HANDBUCH DER SYSTEMATISCHEN WEICHTIERKUNDE (1931, 1935), and limited the account to a treatment up to the species level. The artificial keys to the identification of the families, genera, and species are largely based on the one drawn up by F. H. Gravely in his account of the 'Shells and other Animal remains found on the Madras Beach' [*Bull. Madras Govt. Mus.* (*Nat. Hist.*) V (2), 1942]. The main report is followed by a list of seventy important papers on Oriental Mollusca. A useful twelve page index concludes the account.

Essentially a compilation, reports of this nature are bound to have slight shortcomings and this one is no exception. The keys given for the identification of the genera and species are by themselves sufficiently descriptive and this when added to the notes under the different genera and species has tended to make the report unnecessarily bulky. In view of lengthiness of the keys and the fact that the sequence of arrangement of the genera and the species in the text differs from that in the keys, it would have been desirable to give the page number after each genus and species in the keys. Another drawback is the absence of the known natural distribution of the various species in the account. Again, since the author had himself had the opportunity of visiting Krusadai to collect material for the report, the addition of ecological notes on the various species would have greatly enhanced the value of the work by raising it from a bare description of dry shells and pickled specimens! An unpardonable feature is the very bad printing of the plates and the very poor quality paper used for them. In this the printers have failed to do justice to the good drawings.

Having visited Krusadai on different occasions, and like many felt the need for an adequate work on the molluscan fauna of the area, the reviewer has pleasure in congratulating Dr. Satyamurti for bringing out this timely report. It is a distinct achievement to have compiled this account the scope of which is not entirely restricted to Krusadai. Many of the species described are found all along the Indian coast and far beyond, and hence the keys to their identification along with the numerous illustrations (almost all the species are illustrated) will make this a useful guide. We should look forward to this and similar regional reports as eventually forming the basis for a critical and comprehensive work on the littoral molluscan fauna of India.

E. G. S.

6. MICROSCOPE: CONSTRUCTION, USE AND CARE. By Y. K. Sane. Pp. 1-24. June 1957. Size 5-1/3″×8¼″. Price 50 nP.

A basic knowledge of the working and uses of a microscope are essentials that even elementary science students should know and a good grounding in the details will undoubtedly stimulate greater interest in the user to probe into the finer aspects of nature. The author has compiled a useful and handy pamphlet on the subject which should be popular both among teachers and students alike. The text is written in a simple and easily understandable style and is illustrated with nine drawings. Teachers and college students will find some additional and useful hints in the 7-page appendix given at the end. The price of 50 nP. places this booklet within the easy reach of all students.

E. G. S.

7. JOURNAL OF THE PALAEONTOLOGICAL SOCIETY OF INDIA. Vol. 1 No. 1. Pp. 229+xxxvi (11″×9″). With 37 plates, and many line drawings. Published by The Palaeontological Society of India, Lucknow 1956. Price Rs. 30.

The aims and objectives of the Palaeontological Society of India are researches in palaeontology, palaeobotany, and prehistory. The foreword to this inaugural number of its journal has been written by the Prime

Minister, Shri Jawaharlal Nehru. His interest in science is well known to all Indian scientists. Here he reveals that while at Cambridge he studied geology as one of the subjects. He points out why it is important to study palaeontology no matter whether one is engaged in the pure or applied aspects of the subject. The journal has also the blessings of the late Dr. S. S. Bhatnagar and of his successor Prof. M. S. Thacker.

Dr. M. R. Sahni, the founder-president of the Society, gives a review of the research carried out in India, Pakistan, Burma, and Ceylon during the last hundred years. His researches indicate that the first fossil plant was reported in India in 1810, the first invertebrates in 1831 and 1860, and the first palaeolith in 1863.

Altogether there are 32 articles in this issue the majority of which deal with palaeontology. Only six articles deal with palaeobotanical matters. There are also a few other papers relating to subjects like evolution, and the use of Statistics in evolution and prehistory. Amongst the authors of these articles we find names of well known foreign scientists like J. B.S. Haldane, Otto Schindewolf, Le Gros Clark, L. R. Cox, B. F. Howell, C. A. Arnold, and others. These names are sufficient indication of the standard of the articles published in this volume. Amongst the active senior workers of the Indian zone there are papers by M. R. Sahni, Evans and Nagappa, Shankalia and Deraniyagala. All told, this inaugural number sets a very high standard for the journal which it is hoped that future issues will be able to maintain. It should not be difficult to do so considering the fact that there exists at present in the Indian zone a team of good workers in different branches of the science the journal deals with, and there is also offer of co-operation from many foreign workers. Dr. M. R. Sahni deserves our heartiest congratulations for starting such a valuable journal in India.

K. A. CHOWDHURY

8. KNAURS VOGELBUCH. By Georg Steinbacher. Pp. 271 (19×12 cm.), with 48 coloured plates, several in black-and-white line, and numerous text figures. 1957. Publishers: Droemersche Verlagsanstalt Th. Knaur Nachf., Munchen & Zurich. Price ?

This book, written by the Director of the Augsburg Zoo, will prove invaluable to bird fanciers, aviary keepers, zoological gardens, and bird dealers, who often experience great difficulty in correctly identifying and determining the provenance of exotic species in their stock or collection, and in providing them with adequate food and care.

The attractive and beautifully reproduced coloured illustrations of 200 species, mostly of tropical birds, belong to many natural Orders—including finches, starlings, bulbuls, parrots, thrushes, birds of paradise, pies, toucans, pheasants and other game birds, and waterfowl. They are from paintings by one of Germany's foremost bird artists and for the non-German-knowing bird-lover constitute the most irresistible feature of the book. The numerous text figures showing different types of cages, feeding trays, baths, nest boxes, and other accessories and gadgets should prove of the greatest usefulness to the bird keeper. Detailed hints on foods, feeding and care, and the breeding in captivity of individual species and families are furnished and, although the text is in German, the usefulness of the book is not greatly diminished nevertheless. The illustrations alone justify a place for it in the library of every zoo and serious bird fancier.

S.A.

9. A COMPANY OF BIRDS. By Loke Wan Tho. Pp. 174 (10″×7½″). 1 coloured and 107 black-and-white photographs. London, 1957. Michael Joseph Limited. 42*s.* net.

When, during the last war, Loke Wan Tho of Singapore found himself in Bombay, suddenly free from the pressure of any business, indeed of any occupation, he casually began to dabble once more with his old hobby of bird photography. He used the war years to such good purpose that today he is accepted as one of the best bird photographers in the world.

Loke's camera, it would seem, has a sharper eye than the most powerful pair of binoculars. It can capture the very texture of every hair and feather on the bird's body, and it can bring out the triumphant gleam in the bird's eye as it returns to the nest with what Loke calls the 'family groceries'. And though he can record every physical detail, his technical virtuosity is always dominated and directed by the high aesthetic standard which he sets for himself. Loke manages to 'pose' his sitter in the most picturesque attitudes; and he manages to arrange the light so that the finished picture has the look of a studio portrait by an artist. The picture of the Sea Eagle, in order to secure which he took, as Mr. Malcolm MacDonald says in the foreword, the most extraordinary risks, is a gracious portrait of a beautiful and dignified bird. Impossible to suspect that the photographer was huddled on top of a flimsy structure 130 feet high, roasting in the sun and giddy from the motion as the tower swayed in the breeze.

The photographs in the book are divided into three sections, the birds of India, the birds of New Guinea, and the birds of Malaya. Each plate is accompanied by lively field notes about the bird's habits and behaviour. It is useless to attempt to single out any picture for special praise. Many of the pictures taken in New Guinea are scientific triumphs and unique in that they are the first pictures of a bird which had never been photographed before, or the only known proof of a particular nest, and so on. In spite of this, it is the affectionate studies of the commoner birds of Malaya, the warblers, the robins, and the bulbuls, to which one turns again and again. Perhaps the reason is that, having acknowledged in him a very good ornithologist, an entertaining writer, and a superb craftsman, it is the artist in him whose work ultimately holds our attention and our admiration.

L.F.

Miscellaneous Notes

1. THE BREEDING SEASON OF THE RHESUS MONKEY *MACACA MULATTA* (ZIMMERMANN) IN RAJASTHAN

During the year March 1956 to February 1957 only one troop of these monkeys was watched. The troop consisted of 20 full-grown females and 15 sub-adults. It was headed by a big male. Five-to ten-days old young were observed clinging to the breasts of their mothers between 25 March and 7 May, and again between 28 September and 8 October.

In order to confirm these observations, this troop (i) was observed again from March 1957 to December 1957; and to counter-check the observations two more troops near Jaipur were watched regularly during the year. Troop I now consists of 27 full-grown females, 4 males, and 21 sub-adults. The troop moves in the Chandpole area of the city. Troop II from the Ramganj area has 25 adults and 15 sub-adults. Troop III is a larger one and consists of over 100 monkeys. It inhabits Galta, a hilly holy place 6 miles away from Jaipur City.

These troops were observed more regularly during March to May and September to October.

Newly-born young were first observed on 23 March in troop III. Most of the females of the three troops delivered during the fortnight 23 March to 7 April. About 40 cases were observed. No newly born young were observed thereafter till 1 May when a female in troop I was seen clasping a baby. The females of troops II and III also delivered till 10 May: 4 cases in troop I, 3 in troop II, and 8 in troop III. The females again delivered during 28 September to 10 October. The deliveries were: 5 in troop I, 4 in troop II and 7 in troop III.

My observations were also confirmed by a monkey seller who is doing this business for a considerable time in Jaipur.

It appears that in this region the monkey, *Macaca mulatta,* chiefly breeds twice a year.

DEPT. OF ZOOLOGY,
MAHARAJA'S COLLEGE,
JAIPUR,
January 10th, 1958.

ISHWAR PRAKASH

2. THE USEFULNESS OF BATS

Dr. Adam Krzanowski, a chiropterologist of Poland, has sent us a note on bats as an important secondary aid in locust control. He mentions in this context the common Pallid Bat (*Antrozous pallidus*) of southern and western U.S.A. which, it seems, is in some ways specially adapted for the destruction of locusts. It takes its prey mostly off the ground, rarely also in the air. Its food consists chiefly of orthoptera, grasshoppers, locusts, etc., besides which it preys on moths, beetles, and even small scorpions. Its food is easy to study qualitatively since, like our Indian *Megaderma lyra*, its habit is to devour its prey hanging in a favourite spot under which accumulate dropped wings and other uneatable portions of the quarry enabling the different items to be identified. Dr. Krzanowski suggests that there are possibly some other Indian species also whose economic status as destroyers of locusts and other insect pests might be profitably investigated by a properly organized study, including their population densities and local and seasonal movements.

With reference to two notes recently published in the *Journal* [Vol. **50** (2): 401-3] on the destruction of Flying Foxes, Dr. Krzanowski suggests it might be worth while to investigate the possibilities of utilizing the skins and fur of these animals in the manufacture of fancy articles for export to foreign countries where, with proper publicity and advertising, they could easily create a fashionable and lucrative demand. Both needs could thus be satisfied, the eradication of excessive numbers of these destructive fruit bats and the earning of much-needed foreign exchange.

Scientific research on the life-history and economic status of Indian birds and other animals is a need which the Bombay Natural History Society has constantly and repeatedly stressed. In a country like ours, which is so largely dependent on its agriculture and forests, this research calls for the highest priority.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
FORT, BOMBAY 1,
February 15, 1958.

EDITORS

3. PORCUPINES AND TREES OF *VERNONIA* SP.

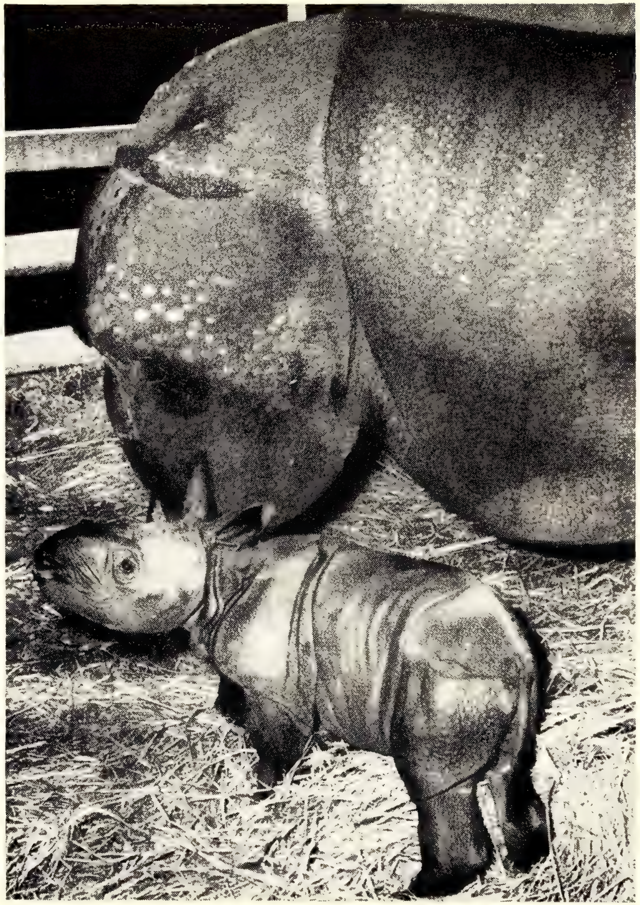
A day or two ago I passed a very large digging round the roots of a species of *Vernonia*, a tree growing at an elevation of 5,000 to 6,000 feet on the Billigirirangans, known locally as Khan Karragillu. My comment that it was the work of a bear was contradicted by my sholags. After an examination of the hole they pronounced it to be the work of porcupines, which I was told at times appeared to go berserk over the roots. This species of *Vernonia* is a common tree in evergreen sholas here, and especially noticeable for its mauve blossoms in September-November. As this is the first instance that has come to my notice of porcupines almost fully devouring the roots of a medium-sized tree, I shall be interested to hear of similar cases.

DUPABURRAY BUNGALOW,
ATTIKAN P.O.,
VIA MYSORE, SOUTH INDIA, R. C. MORRIS
February 3, 1958.

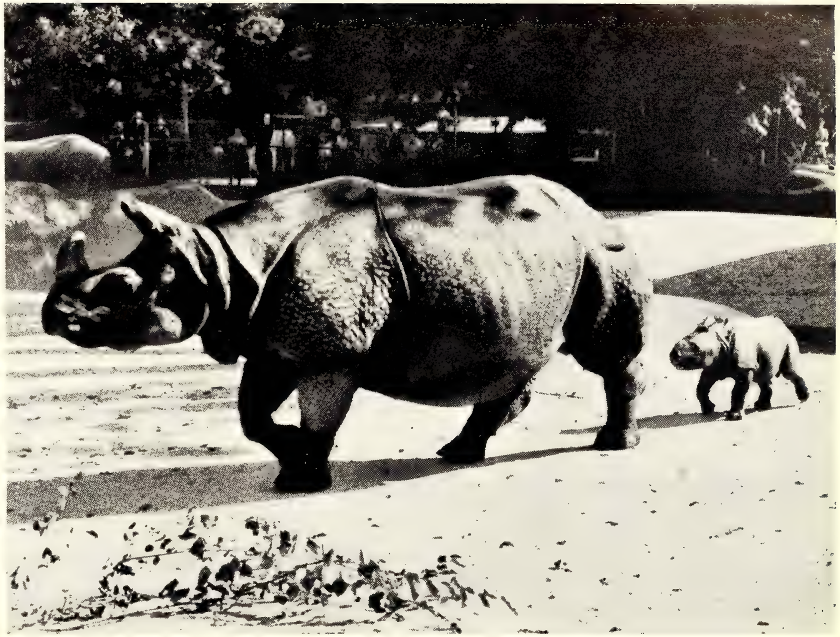
4. RABBITS AND MYXOMATOSIS IN THE U.K.

That myxomatosis swept England and Scotland and killed out 97% of the rabbits is well known. On our property in Devon I saw disease-affected rabbits with swollen heads nibbling corn shoots, which seemed to belie the belief that they suffered agonies. Their fleas were the carriers from burrow to burrow. What of the 3 per cent survivors? It has been said that there were 'pockets' where the disease missed the local rabbit population. Perhaps in some instances this was so, but it has been found that the rabbits in such case were chiefly surface dwellers, living amongst bracken and brambles, and were not affected by the fleas in the burrows. Their progeny have multiplied, and the rabbits now increasing in a number of countries in England are the surface dwellers, and the terrific damage to the hedges, especially in the west, by the network of tunnels known as burrows is still a thing of the past. The surface-dwelling rabbits do just as much damage to corn as well as to young forest plantations as their burrowing brethren, but they are lucky in that the strength of the myxomatosis virus appears to have weakened and they seem to get a milder form of the disease which renders them immune. Or may it be that the disease is not so fatal in respect of surface dwelling rabbits? So now we have an immune (or partially so) species of surface rabbits, increasing rapidly and taking the place of the burrowing species. The colossal damage caused by rabbits in respect of both arable crops and plantations was fully realised only when the disease knocked them out. The damage far exceeded the value of their meat and fur.

DUPABURRAY BUNGALOW,
ATTIKAN P.O.,
VIA MYSORE, SOUTH INDIA, R. C. MORRIS
February 1, 1958.



About two hours after birth. Basel Zoo.



The week-old " Rudra " following its mother in the paddock.

(By courtesy *Zoological Garden, Basel*)

5. BIRTH OF A GREAT INDIAN RHINOCEROS IN CAPTIVITY

(*With a plate*)

The annual report (1956) of the Basel Zoo, Switzerland, contains an interesting account of the birth of a calf to the pair of Indian rhinos. Gadadhar the male and Joymoti the female were acquired from the Kaziranga Sanctuary as young animals in 1951 and 1952 respectively, and have since grown to maturity.

From certain symptoms, and from the behaviour of the animals at the beginning of 1956, it was suspected that the female was pregnant though frequent analyses of the urine gave negative results. At the end of April, however, movements of the foetus were discernible each time the female drank cold water. The calf was born on 14 September, the gestation period calculated from the last 'heat' in the female being 474 days. The mother immediately licked her baby clean, and then lay down beside it on the bedding straw. The calf (christened Rudra) made its first efforts to stand up 25 minutes after it was born, but succeeded in doing so only half an hour later. It first fed from its mother after two hours. Some time later the mother ate up the entire after-birth. Rudra's weight and length at birth, and monthly thereafter, are given as follows:

	Date	Weight (kilos)	Length (cm.)
1956	14 Sept. (at birth)	60·5	105
	13 Oct.	111	127
	10 Nov.	157	146
	15 Dec.	215	160
1957	15 Jan.	268	168
	15 Feb.	316	176
	16 Mar.	349	190

There are some interesting details given about the behaviour of the young. Soon after birth the colour of the skin was almost violet, with all the folds of the armour-plating as prominent as its mother's. The margins of the ears were fringed with a growth of hair *c.* 3 cm. long, and also the tail tuft was well developed. After some days the skin colour changed to the normal grey-brown of the adult, though the joints of the armour showed up reddish.

In a subsequent letter (dated 18 July 1957) Dr. Lang the Zoo Director writes that Rudra is flourishing and growing apace. Its weight at the time of writing, when just about 8 months old, was over 1,000 lb. The parents mated again and Joymoti has apparently become pregnant once more. Dr. Lang hopes to ascertain the exact gestation period this time.

In the only previously known instance of an Indian rhino born in captivity (Calcutta Zoo, see *JBNHS* **31**: 1031, 1927) the gestation period was estimated as about 19 months. Earlier Hodgson had given it as 17 to 18 months.

For the African Twohorned Rhinonceros (*Rhinoceros bicornis*) the period of gestation is given as 530-570 days (THE NATURAL HISTORY OF MAMMALS by F. Bourliere: 165, 1955).

Since the birth in the Basel Zoo a further 'domestic occurrence' in the world of captive Indian rhinos has been reported. A calf was born in November 1957 to Mohini the female of the pair living in Whipsnade Park, U.K., since 1952. The gestation period in this case is said to have been 16 months. The calf at birth was about 22 inches in length and about 18 inches high, and estimated to weigh between 85-100 lb.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
FORT, BOMBAY 1, EDITORS
November 27, 1957.

6. THE MUNTJAC IN BRITAIN

The muntjac—frequently called the Barking Deer or Rib-faced Deer, by reason of its vocal powers or facial appearance—was first liberated about 1900 by the eleventh Duke of Bedford into the woods both inside and outside his park at Woburn. The original deer were the Indian race—*Muntiacus muntjak* —but after a time, partly because the bucks were proving dangerous to small dogs but mainly to make room for the smaller Reeves's Muntjac—*Muntiacus reevesi,* a native of China —efforts were made to kill off the Indian race. This was not completely achieved and the two races have inter-bred.

From Woburn this small deer has now extended its range into all adjacent counties, which include Bedfordshire, Buckinghamshire, Hertfordshire, and Northamptonshire, whilst individual animals have been reported as far afield as south Leicestershire and Essex.

As regards an estimate of the number of muntjac at large in Britain, this is of course almost impossible but I would say it was not less than 400 and might be up to 1,000. Northwest they have been recorded as much as sixty miles from Woburn and in the south-westerly direction quite a large number exist in the Bicester area which is about 25 miles from Woburn. In an easterly direction isolated reports have come from places 60 miles from Woburn but whether these animals have wandered there or been planted is not certain.

THE OLD HOUSE, WITHNELL FOLD,
CHORLEY. LANCS., ENGLAND.

G. KENNETH WHITEHEAD

January 24, 1958.

7. ADDITIONS TO THE BIRDS OF THE PALNI HILLS (SOUTH INDIA)

Subsequent to my notes published on pages 265-267 of Volume **53** of the *Journal*, I have collected a few more birds in the Palni Hills the following of which appear to be new records for that area:

1. **Chloropsis aurifrons insularis** Kinnear & Whistler: Goldfronted Chloropsis

Palni foothills, 1,500 ft., near Periakulam, 26-5-1956.

2. **Hypothymis azurea styani** (Hartlaub): Blacknaped Blue Flycatcher

Five specimens, Manalur Cardamom and Coffee Estate, 4,000 ft., 18-5-1956.

3. **Lanius vittatus** Valenciennes: Baybacked Shrike

Foothills near Aiyampalayam, 1,000 ft., 20-5-1956.

4. **Cacomantis merulinus passerinus** (Vahl): Plaintive Cuckoo

Pambar Valley opposite Periakulam, 1,000 ft., 27-5-1956.

5. **Hydrophasianus chirurgus** (Scopoli): Pheasant-tailed Jaçana

Needamangalam, a small irrigation tank situated between Palni Town and the foothills which climb to Perumalmalai, 30-4-1957.

6. **Gorsachius melanolophus melanolophus** (Raffles): Malay Bittern

Captured alive by American schoolboys at 'Bombay Shola', Kodaikanal, 7,000 ft., and reared for three weeks on tadpoles and frogs; now in the Shembaganur Museum, 7-4-1957.

7. **Microtarsus poioicephalus** (Jerdon): Greyheaded Bulbul

9-5-1957. This species has already been recorded for the Palnis, but is mentioned here because the specimen was collected as high as 4,000 ft., near Machur along the motor road from Batlagundu to Kodaikanal, the earlier ones being from the foothills.

It may also be of interest to record that I obtained specimens of the Brown Flycatcher, *Alseonax latirostris latirostris* (Raffles), and of the Paradise Flycatcher, *Tchitrea paradisi*, on 24th and 19th May 1956 respectively. Sálim Ali has already suggested (THE BIRDS OF TRAVANCORE AND COCHIN, p. 78) that small numbers of the Brown Flycatcher may be resident in Travancore and Cochin as also the typical race of the Paradise Flycatcher. Stewart is said to have taken a nest of the latter in Travancore.

LOYOLA COLLEGE,
MADRAS 31,
January 6, 1958.

NORMAN FULLER S.J.

8. A NEW RACE OF THE WHITERUMPED SWIFT

In connection with my review of the genus *Apus* (*Ibis* 1956: 34-62), I overlooked some specimens from SE. Tibet which Ludlow and Kinnear (*Ibis* 1944: 372) referred to *A. pacificus leuconyx*, but which Mr. Sálim Ali has pointed out to me could not belong to this race owing to their much longer wings. The five specimens, now in the British Museum (Natural History), are males collected at Molo on 24 June 1936 and Nanda on 17 July 1937 and 20 August 1938, at a height of 11,200 to 11,500 feet above sea-level, and the birds were described as breeding commonly under the eaves of houses and in stone towers in the lower Tsangpo Valley.

The wing-length as measured by me was 173-179 mm. (mean 176 mm.), which places them far outside the normal limits for *A. p. leuconyx* of 147-160 mm., and well in the range of the nominate form of 168-195 mm. However, the specimens have darker upper parts, a decidedly narrower white rump, and much narrower white tips to the feathers of the underparts than *A. p. pacificus*, and in all these characters are extremely similar to, if not indistinguishable from, *A. p. leuconyx*. South-eastern Tibet lies south and west of the known range of *A. p. pacificus* as given by Peters (BIRDS OF THE WORLD 4: 249) while *A. p. leuconyx* breeds further south. Since these Tibetan birds are completely separable from *A. p. pacificus* by colour and from *A. p. leuconyx* by size, they represent a distinctive race, which I propose to name

Apus pacificus sâlimalii subsp. nov.

designating the type specimen as a male collected by F. Ludlow at

Molo, Chu Valley, SE. Tibet, on 24 June 1936, British Museum catalogue no. 1937.1.17.109.

EDWARD GREY INSTITUTE OF FIELD ORNITHOLOGY,
OXFORD, U.K., DAVID LACK
February 17, 1958.

9. VARIATION IN THE OUTPUT OF SONG OF A SPOTTED DOVE, *STREPTOPELIA CHINENSIS* (SCOPOLI)

During April and May 1951, observations were carried out on the length of time for which a Spotted Dove, *Streptopelia chinensis*, called and the variations that occurred in the duration of the call while the bird was engaged in duties connected with breeding. Starting with the assumption that bird song is a result of the excessive energy which a bird develops during the breeding season, it was argued that as the work of nest building, hatching, and the feeding of the young absorbed more and more of the energy of the bird the output of song would correspondingly get less and less. At the same time in the intervals between these tasks when the demand on the energy of the bird diminished, the output of song would increase. In other words the maximum output should be during courting and just prior to nest building, followed by subsidiary maxima in the intervals between nest building and egg laying, egg hatching and the emergence of the young, and after the young leave the nest. For this it was necessary to pick out a pair that was fairly isolated and not liable to confusion with others. A pair of Spotted Doves were kept under observation for some time until it was certain that they were a real pair and were generally confined to the compound of the Forest Rest House at Doranda in Ranchi. Also no other pairs frequented the compound and therefore any calls recorded would be of this pair. The sexes were differentiated by minute observation, and it was determined that the male had one of the outer tail feathers missing. The sex was established by noting their positions during mating. The call of this bird only was recorded, the calls of the other being ignored. The times were recorded by a centre-second Rolex Oyster watch and observations were carried out from dawn to dusk. The total duration of call within 5 minutes was recorded at 5-minute intervals; of course, such periods during which there was no call being not recorded. The following ancillary observations on the habits of the bird were also made and are given here:

Display: Three kinds of display were noticed. One kind was while the male was courting the female on a tree. The male would inflate its neck, bow and drag his tail, without fanning it out, along the branch, calling all the while. The whole process could be likened to a crawl. The second is performed on the ground. Here the male has the breast almost touching the ground, the breast feathers are inflated, the wings are slightly expanded with the tips almost trailing along the ground, and the unexpanded tail is dragged. His effort appears to be to somehow touch the female with his wing tips. For this he actually parades round her with quick short steps sometimes getting in front of her, sometimes behind her, and often by her side. In other words there is no circular movement round her. He keeps on calling all the time. The third is an aerial display. The male shoots up into the air with a whirr, and glides down on motionless wings, raising and expanding its tail, to a perch near the female. This display is indulged in most frequently and was observed up to six or seven times during the day. The female is indifferent all the time, never calls, evades the male, and generally flies away. Only once did I notice the female invite mating. On the 24th April 1951, the female invited the male to mate with her, while the male was displaying on a tree, by raising her tail and jerking it slightly.

Guarding of Territory: The territory is not guarded very closely. They do go beyond their territory but recognise the boundaries. If they have strayed into the territory of another pair they retire immediately on the approach of the owners, and fights are very rare. On a few occasions an attempt at a fight was noticed by two birds coming close together and striking with their bills. The nest is also left equally carelessly and no attempt is made to ward off intruders. Rather their nest is better looked after by other species. I frequently noticed a Redvented Bulbul (*Pycnonotus cafer*) drive off Koels (*Eudynamys scolopacea*) from the vicinity of the nest of this particular pair by perching on the back of the escaping Koel and pecking furiously at its head.

Nest-building: The bulk of material is brought by the male, who does so at intervals of approximately 10 minutes. He is very choosy about the twigs that he selects and frequently discards a number, picking them up and throwing them away, before he gets one to his liking. The female arranges them and constructs the nest using her bill and feet. She changes her position frequently. While bringing materials the male first alights on a near-by tree, looks all round to ensure that the coast is clear, and then approaches the nest. Neither of them calls while engaged on this work, as also they both become very shy.

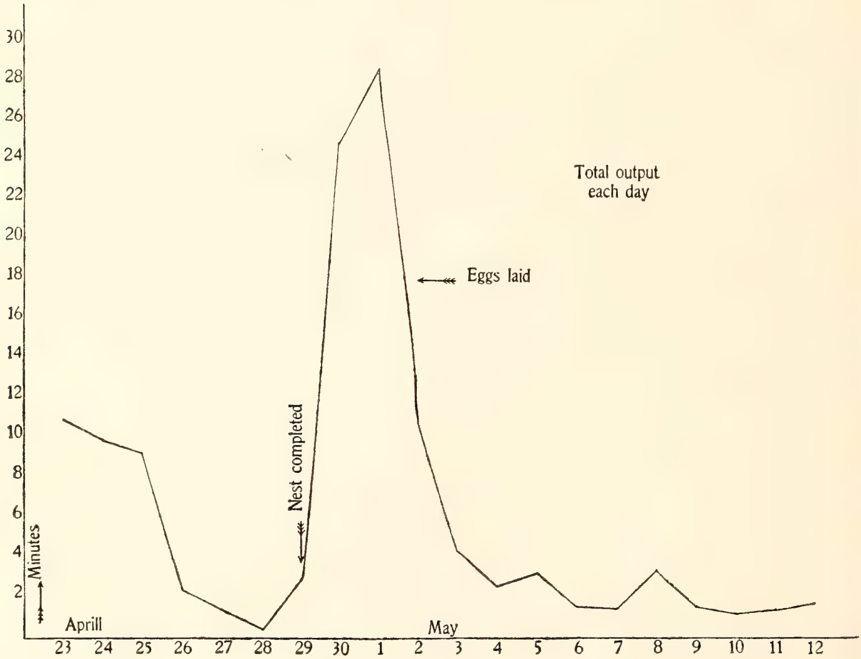
When the female gets tired she quietly leaves the nest and starts feeding close by. As soon as the male becomes aware of it he at once takes her place. At this time the female may bring some materials and the male may build. But generally as soon as the female has fed enough she returns to the nest and the male reverts to his original role. They work on the nest from around 7.30 a.m. to 11 a.m. or so, and never in the afternoon or evening. They roost on a tree very close to the nest.

In this particular case the nest was placed about 4 feet from the ground in a *Duranta* hedge. The nest was a scanty platform of small twigs of Silver Oak (*Grevillea robusta*) and Eucalyptus, and weeds. It was a very frail structure and the eggs could be seen from below. The eggs were laid after dusk, and the two eggs were laid on two consecutive nights. The eggs were a plain polished white. The male and the female both incubate, the male doing it mostly during the day and the female at night.

The observations were started when it became clear from the behaviour of the birds that they were about to nest. The observations were begun on 23rd April 1951, and continued every day till 12th May. No observations could be made on the afternoon of 26th April and all next day due to sickness. Apart from this, a continuous watch was maintained throughout the period. Unfortunately a complete case history could not be obtained as the eggs were destroyed by a rat on the night of 12th May 1951. The birds thereafter abandoned the nest and the observations had to stop. It may be mentioned in passing that out of several pairs of Spotted Doves I noticed in Doranda not one succeeded in producing young ones. Nests were built and eggs laid, but due to the flimsy structure of the nests the eggs were always destroyed, either by enemies or by just dropping out of the nests before they were hatched. I have yet to see a young Spotted Dove in Doranda.

Analysis of Observations: 23rd April 1951 was clear and pleasant, slightly hot at midday. A light breeze started in the morning from west to east but freshened as the day progressed. This was a day devoted to courtship and display, resulting in a total duration of call of 11 minutes 4 seconds during the day. It is significant that while displaying the duration of each run of calling was from 4 to 6 seconds, though the average duration is only 2-3 seconds. Each 'coo' takes half a second and is very exact. The 24th, 25th, and 26th were a repetition of the 23rd with almost identical weather condition, giving a total duration of call for the day of 9 minutes 55 seconds, 9 minutes 20 seconds, and 2 minutes 30 seconds (morning only) respectively. The 28th and 29th were devoted to nest building and there was a marked dimunition in the total output of song, being 23 seconds and 3 minutes 3 seconds respectively. The days were sunny and hot with a stiff breeze blowing the whole day from west to east. The nest was completed on the 29th. On 30th April and 1st May the male was entirely free to devote himself to courtship and mating, and this produced the biggest total output of song. On the 30th the total output was 25 minutes 5 seconds and on the 1st 28 minutes 47 seconds. Egg laying was completed on the night of 1st/2nd May, and with the call on energy made by incubation the output of song showed a marked dimunition, being 10 minutes 51 seconds only on 2nd May. From 3rd May onwards incubation started in right earnest and the duration of song came down to 4 minutes 21 seconds on the 3rd, and was only about 1½ minutes from 4th to 12th May, when the eggs were finally destroyed.

Other interesting facts that emerge are that the heat of the day affects the calling of this bird, and it is sensitive to changes in weather conditions. On practically all days it was silent from approximately 12 noon till after 4 p.m. The exceptions were 30th April and 1st May when it continued calling till about 2 p.m. Immediately before actual mating look place the duration of the calling increased; on 30th April and 1st May, while the normal duration continued to be 2-3 seconds, the bird called for as long as 12 seconds before mating.



Again whilst nest building was in progress the bird stopped calling at 9.45 a.m. and 11.55 a.m. on 29th and 30th April. When incubation started, it similarly stopped calling early in the day, being completely silent after 9.30 a.m., from the 5th May onwards. Rainfall or a reduction in temperature induces the bird to call. Rain fell around 4 p.m. on 30th April and 1st May, giving rise to subsidiary peaks in the calling around 4 p.m. In general, the bird stopped calling much before sunset though it began before sunrise.

A curve showing the variation in the output of song each day is given, as also a table showing separately the output of song for each half of the day.

Date	Output of song		Total for the day	REMARKS
	Dawn to 12 noon	12 noon to dusk		
23-4-51	10′-27″	37″	11′-4″	No calls from 12-20 p.m. to 16-05 p.m.
24-4-51	9′-13″	42″	9′-55″	No calls from 12-35 p.m. to 16.00 p.m.
25-4-51	9′-6″	14″	9′-20″	No calls from 12.00 p.m. to 16.05 p.m.
26-4-51	2′-30″	No observation		
27-4-51				No observation due to sickness.
28-4-51	23″	Nil	23″	No calls after 9.45 a.m.
29-4-51	3′-3″	Nil	3′-3″	No calls after 11.55 a.m.
30-4-51	22′-30″	2′-35″	25′-5″	No calls between 13.55 p.m. and 17.30 p.m.
1-5-51	28′-26″	21″	28′-47″	No calls between 13.50 p.m. and 16.00 p.m.
2-5-51	10′-35″	16″	10′-51″	No calls between 11.25 a.m. and 16.30 p.m.
3-5-51	4′-5″	16″	4′-21″	No calls between 10.30 a.m. and 16.30 p.m.
4-5-51	2′-30″	10″	2′-40″	No calls between 9.05 a.m. and 15.35 p.m.
5-5-51	3′-31″	Nil	3′-31″	No calls after 9.25 a.m.
6-5-51	1′-33″	Nil	1′-33″	No calls after 9.05 a.m.
7-5-51	1′-30″	Nil	1′-30″	No calls after 7.20 a.m.
8-5-51	3′-17″	9″	3′-26″	No calls between 8.30 a.m. and 17.40 p.m.
9-5-51	1′-38″	Nil	1′-38″	No calls after 8.10 a.m.
10-5-51	1′-12″	Nil	1′-12″	No calls after 6.50 a.m.
11-5-51	1′-20″	Nil	1′-20″	No calls after 8.05 a.m.
12-5-51	1′-41″	Nil	1′-41″	No calls after 6.00 a.m.

Note— ′=Minutes ; ″=Seconds.

On the night of the 12th some commotion was heard near the nest and a rat was heard squeaking. The dove apparently fought silently as its calls were not heard. Investigation on the morning of the 13th showed that the eggs had been destroyed and a few feathers of the dove were lying scattered about in the hedge near the site of the nest. As the eggs had been destroyed no further observations were recorded.

DORANDA,
HINOO P.O., JAMAL ARA
RANCHI, BIHAR,
June 25, 1957.

10. NOTES ON THE SARUS CRANE

EARLY 'IMPRINTING' OF VITAL COMMANDS

One of the papers read at the XIth International Ornithological Congress at Basel in 1954 concerned the psychological change that takes place with brooding waders and other birds just before and at the hatch of the first egg. Sound recordings by means of a microphone concealed within a few feet of the nest of a Stone Curlew made possible an analysis of the low conversational calls exchanged, inaudible to the human ear, which evidently establish the bond between the parent and the unborn cheeping chick so that, when it emerges from the shell, it is not in a completely strange world but already 'imprinted' with the voice of the parent who will be its guide and protector in early life.

I was reminded of these observations in Bharatpur recently (Sept. 1957) while watching two pairs of Sarus cranes. One pair was leading two cinnamon coloured downy chicks *c.* 4 days old, the other at a nest with two eggs. One of the eggs was chipped, and from a hide 25 ft. away I could watch the whole process of the chick struggling out of the shell.

The first pair were very alert from the beginning and began to lead away the chicks as soon as they suspected they were being closely observed. The terrain was grassy marshland, pock-marked by hoof-prints of cattle and small shallow puddles here and there. The parents were walking ahead fairly fast, turning their heads concernedly to follow the observer's movements all the time; the two chicks toddled innocently some 10 yards behind completely oblivious of anything untoward. Just when the stumbling chicks reached a shallow grass-covered puddle which the parents had already crossed, one of the adults (male? as larger) gave a series of short staccato calls—a subdued *kor-r-r*—upon which the chicks vanished as if by magic. As I had my attention fixed on the parents I did not actually see them in the act of vanishing, or the exact spot at which this happened. But when a second later I looked for them, they were simply not there!

Having thus disposed of the chicks, the male began the most extraordinary diversionary tactics to draw away my attention. He half crouched with lowered neck as if furtively slinking away, and in this manner made a semicircle some 20 yards in front of me and back again. In the course of this he waded into an open knee-deep puddle, spread out and drooped his wings, dipped forward until his breast and underparts were almost touching the water, and did everything to simulate dire distress. During these manoeuvres he once jinked quite realistically for a fraction of a second as if recoiling from something suspicious seen in the water. It is possible that he had actually seen something to alarm him then. Variations of this distress display continued for about ten minutes, accompanied off and on by loud agitated trumpetings as if to summon outside assistance in which the female (?) joined in a duet. She had removed herself about 50 yards away from the displaying bird, not partaking in any of his fantastic behaviour but sedately stalking around with an air of nonchalance and unconcern. Here she was occasionally joined by the male in between his demonstrations.

Soon the male ended these extraordinary antics and flew off about 300 yards, across a bund in the marsh into the territory of a neighbouring pair of saruses, calling loudly all the while as if appealing for help. He presently returned bringing back with him a new companion, which now made altogether three saruses on the spot. After giving some 'moral support' to the aggrieved pair which consisted of joining in their loud trumpetings, this new-comer flew back to his own 'compound'. The pair seemed somewhat fortified and now moved about in pretended unconcern, duetting frequently in answer to calls from distant pairs. Their trumpetings were occasionally interpolated with the short staccato '*kor-r-r*', obviously a command to the chicks to continue lying doggo.

It took me a long time to discover one of the chicks, and that when all but trod upon; the other remained unseen in spite of a thorough search. This chick was lying doggo concealed among longish grass in the puddle, partially submerged with only the top of its back and head to the eyes showing above the water, with neck fully stretched in front and beak resting on the grass at a slight upward angle. It remained completely motionless even when approached to within a foot, and continued so for over the half hour during which I was splashing about in its proximity looking for its companion. The parents appeared to have calmed down considerably and kept a hundred yards or so away on dry ground pretending to be unconcerned. Earlier, when the chicks had just been commanded to freeze the male (?) would often advance purposefully straight at the observer to within ten yards or so trumpeting loudly and threateningly.

On 24 September I had the good fortune to observe one of a clutch of two eggs in a nest hatch, and the complete process of the chick emerging. At 9 a.m. the egg had chipped, and portions of the creamy cinnamon down of the stirring and cheeping chick within could be seen through the hole. By 10 o'clock the chick struggled completely free of the shell, eyes wide open; but it was feeble and exhausted, unable to lift its head and falling about helplessly. By 11 the down had dried and become velvety, and the chick was able to raise its head unsteadily and to shuffle about in the nest cheeping loudly. The female brooded from time to time or stood by to look on with bill lowered into the nest. Soon after the chick had freed itself clear, the nest was visited by both parents together. The mother touched the chick with her bill tenderly, then picked up and swallowed bits of the empty shell in the nest. On a later visit she swallowed some more bits. She removed the bright orange coloured parchment-like membrane lining the shell which had become partly dry and crackly, held it in the tip of her bill, dipped it in water to soften it, and swallowed it when quite limp. She brooded the second egg with most of the empty shell still beside it, leaving the struggling chick uncovered on the periphery of the nest partially hidden from the observer behind the nest mass.

The floundering chick was brooded by the female intermittently with the male in close attendance, clearly much interested in the new arrival, and curious and very much on the alert. Once, on alarm at some movement and noise from within the hide, the sitting parent hastily got up and was about to move away when the chick commenced to cheep loudly. The parent gave the now familiar deep subdued '*kor-r-r*' alert—the command to the chick to be quiet and 'freeze'. The chick, in his innocence, paid no heed to this but continued to shuffle and cheep, whereupon the parent took a step back to the nest, repeated the *kor-r-r* and at the same time gave the chick a gentle peck. The chick reacted instantly, lay down flat and quiet and the parent moved away. Apparently this is how the early post-natal training is given of obedience to the command to lie down and freeze 'until further orders', which I had experienced the previous day, and which must obviously be of vital importance for the preservation of the species. The chick lay completely inert for the next five minutes or so, until the returning parent uttered another distinct note of a similar pattern which signified 'all clear'.

33, Pali Hill,
Bandra, Bombay 20, SÁLIM ALI
December 30, 1957.

11. THE IDENTITY OF THE GULLBILLED TERNS [*GELOCHELIDON NILOTICA* (GMELIN)] IN INDIA

In early March 1953 while waiting for duck in the Salt Lakes near Calcutta, I idly watched Gullbilled Terns (*Gelochelidon nilotica*) flying around and was struck by their apparently quicker wing-beats as compared to those of the same species around Bombay. Reference to the FAUNA indicated two races in India, the typical one described from Egypt said to occur over the whole of India, and a smaller race *affinis* (from Java) of which only one specimen was recorded within Indian limits from the Andamans.

Stuart Baker only refers to breeding records from north-western India, and on the Godavari and the Ganges, specifically stating that it had not been found nesting further east. Later Stanford (*JBNHS* **39**: 867) recorded thousands nesting on an island in the Sundarbans, Khulna District, Bengal, which would presumably be the Javan race and to which my smaller Calcutta birds possibly also belonged.

The wing of the typical race (FAUNA 6: 116) is given as 300-330 mm. (with mention of an exceptional one of 287 mm. on p. 117), and that of *affinis* as 272-292 mm. It is said of the latter that 'the colour above is also a trifle paler, but the difference is hardly discernible, the primaries seem to be generally darker. THE HANDBOOK OF BRITISH BIRDS, Vol. 5, gives the wing measurement of *G. n. nilotica* (Witherby *et al.*) as ♂ 315-332 and ♀ 330, and admits *affinis* as being a smaller race with 'a shorter bill'.

I have examined 21 Indian birds of both sexes available in Bombay and find that the wings range from 274 to 324 mm. (average 299 mm.). If they are divided into two groups with wing above and below 300 mm., we have

10 specimens ranging from 274 to 299 mm.—average 292 mm.,
10 ranging from 301 to 324 mm.—average 309 mm.

We have only three birds from eastern India, i.e. Calcutta, kindly collected by Mr. H. C. Grieve, and these measure 294, 299, and 290 mm.

In three specimens from the Persian Gulf (including one taken off eggs) the wing is 309, 327, and 330 mm.

There is no difference of size between the sexes, and measurements of the bill (from feathers), tarsus, and tail are in keeping with those of *nilotica* as mentioned in the FAUNA and the HANDBOOK.

It would thus appear that birds smaller than the typical *nilotica* occur in India, and that possibly both *nilotica* and *affinis* are found, the latter being more easterly. The identity of the breeding form of northern India as *nilotica* needs to be confirmed, but Stuart Baker is probably correct in assigning it to this larger race which occurs commonly along the west coast at Kutch, Bombay, and Travancore as a non-breeding immigrant.

MESSRS FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY-3,
January 6, 1958.

HUMAYUN ABDULALI

12. THE AVOCET (*RECURVIROSTRA AVOSETTA* LINN.) IN ASSAM

Mr. D. J. Wood of Tocklai Experimental Station, Cinnamara, Assam, reports seeing a party of four avocets on a bheel in the above neighbourhood in Sibsagar District south of the Brahmaputra. This species is rare in Assam. One collected in the Goalpara District in December 1907 (Primrose, *JBNHS* **18**: 683) and another near Charkalia Island in the Brahmaputra (Dibrugarh District) in May 1952 (Sendall, *JBNHS* **50**: 947) being the only instances recorded. It is a vagrant in Burma.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
FORT, BOMBAY 1,
December 26, 1958.

EDITORS

13. CORMORANTS AND EGRETS FISHING IN CO-OPERATION

There is a note by Humayun Abdulali in Vol. **48**, No. 3, page 585 of the *Journal* about egrets fishing in partnership with mergansers. I recently observed egrets feeding in co-operation with cormorants.

I was at Lake Beale, Nasik District, on Christmas Day 1957. At about 2 in the afternoon I saw on the far side of the lake two large flocks of birds one white and the other black. The two flocks were flying slowly meandering close to each other, yet the whites and blacks managed to keep distinctly apart. At this stage I did not pay much attention to the distant birds. I was only struck by the eye-catching contrast of glistening white and black in the setting of water and distant hills. Presently the birds disappeared behind a projecting headland.

About half an hour later, apparently the same birds showed up again quite close on my side of the lake. They must have kept together all this time and flown across the lake, a good half mile in width at this place. There were about 75 Little Cormorants and about 50 Little Egrets with a couple or so of Lesser Egrets with them.

And now for about ten minutes I was treated to a rare display of co-operative fishing between the two species.

Below where I was stationed the shore curved in a sweeping contour and the margin was free from weeds. The land consisting of poor hard soil and *murum* dipped into the water at a fairly even gradient. The egrets were strung along the margin of the lake striding fairly close together in a few inches of water. The cormorants were swimming in a compact column about 10 to 15 feet from the margin where the water must have been less than a couple of feet deep, and kept busy diving excitedly to left and right. The formations of about equal length thus moved slowly forward parallel to each other and to the shore with a narrow ribbon of open water distinctly segregating the whites from the blacks. In both species there was apparent an anxiety to keep their formations alongside each other. Individuals from the egrets would rapidly wade or fly forward in short hops to take up positions to anticipate the leading cormorants coming abreast. In their turn the cormorants were loth to lag behind, the leaders of the column rapidly working up to the foremost egret.

During the few minutes I watched them the birds had thus worked about 50 yards of shoreline when they flew off scared by a distant shot. Quite some time later both the flocks were observed flying in the same general direction and not very far from each other.

ADEN HALL,
NEPEAN SEA ROAD,
BOMBAY,
January 2, 1958.

D. J. PANDAY

14. OCCURRENCE OF THE COMMON FLAMINGO (*PHOENICOPTERUS RUBER* LINN.) AT NANDYAL, ANDHRA STATE

The distribution of the Common Flamingo in India is rather irregular and especially its local migrations during the non-breeding season. Its arrivals and departures at various places are little known, and the bird is said usually to affect salt water or keep close to the sea coast. In view of these, and in response to Mr. Sálim Ali's appeal (*JBNHS* **44**: 476) for more information in India, my recent observation of six flamingos on a small irrigation tank at Nandyal (about 8 miles west of the Nallamalah Ranges of the Eastern Ghats) in the Kurnool District may be of interest.

On 31st December 1957, amidst a large number of White Storks, Openbills, White Ibises, Grey Herons, Little Egrets, and teals that were scattered on the tank, I noticed at about 9.15 a.m. six flamingos (three adults, two post-juveniles and one young) in shallow water at the north-eastern end of the 'small tank' nearer the Nandyal Water Supply Reservoir. All the three adults had red-pink legs but only one of them had the pink bill and wing patch at the side. In the other two adults as well as in the two post-juveniles the bill was dull grey, and the post-juveniles in addition had grey legs as well as grey back and rump. The young one was just of the size of a domestic hen, with complete smoky brown streaked plumage, dark grey legs and bill and, moreover, neither the neck nor the legs were long enough and never looked flamingo-like.

They were all standing close together as a flock amidst teals, Little Egrets, and Grey Herons in the shallow water, sometimes on one leg or with the neck tucked under the wing and the bill projecting behind at the tail end, or occasionally dipping the bill to collect some water in the scoop-like mandible and pour it over the body for preening. Sometimes they all together paraded a few paces forwards into the knee-deep water by a slow and dignified march, and all turned round together as if by command, back once again to the same spot at the water's edge. Strangely enough, when all the other birds flew away on my approach even to 400 yards of them, the flamingos alone stayed back even when I got to within about 150 yards. From here I could clearly observe them through my field glasses for an hour and a half, during which they were quite calm and unperturbed; unfortunately I could not get nearer because of marshy bogs and the tank bed ahead of me. I saw them at the same spot by themselves when all the other birds had gone away even at 1.30 p.m. when I left the tank.

On my next visit to the tank on the following day or the last one on 22nd January 1958, I could not find any flamingos on the tank, although all the other birds were present. On enquiring of the local *shikaris* who frequent this tank, I gathered that they had never seen a flamingo on this tank before.

So obviously, the flamingos I saw may be passing winter visitors, and their presence on this small inland fresh water tank at Nandyal seems worth recording. Moreover, from the descriptions of McCann (*JBNHS* **41**: 12-38) and Sálim Ali (*JBNHS* **45**: 586-593), I am sure that the young one I noticed could not have been more than 2-3 months old and it is therefore interesting that even such young ones along with their parents undertake such long migration presumably from their distant breeding grounds in the Rann of Kutch.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM,
February 6, 1958

P. J. SANJEEVA RAJ

15. JUMPING SNAKES

Reference Mr. D. E. Reuben's note in your April 1956 issue, and that of Mr. H. A. N. Medd on p. 195 of Vol. 54, No. 1: the Russell's Viper (*Vipera russelli*) is well known in Ceylon for its jumping capabilities. There is a well-authenticated story of one attacking a pedestrian in Colombo many years ago in this manner, and on two occasions I have had wounded ones try to jump at me after I had shot them, in each case the charge had hit them in the latter half of the body but they were still able to get off the ground to a height of of about a foot. Both snakes were about 2 ft. 6 in. to 3 ft. long and some 2 to 3 in. thick.

HAMBANTOTA,
CEYLON,
January 6, 1958.

A. E. BUTLER

16. RAT-SNAKES 'MATING'

On the 11th of this month whilst returning from the fields after work at about 4.30 p.m. I saw a very interesting sight of two huge dhamans (rat-snakes) courting. During the act they would stand about 4 feet off the ground and sway about like big cobras and occasionally one would bite the other at the base of the head just like a stallion does whilst covering a mare.

They seemed quite undisturbed at the presence of five or six people watching them from a distance of about ten feet, and now and again one of them would try and puff its neck as if mimicking a cobra.

The coolies insisted that they were cobras and begged me to shoot them, whereupon I went up to them and as they tried to make off caught one of them, which was the slower of the two at getting away, just to show the coolies that there was nothing to fear from them as they were harmless. I measured the one I had caught, with some difficulty, as it had wound considerably round my arm and it measured nearly 10 ft. The other, I think, was about the same length.

C.L.A.I. (M) LTD.,
GOORGHULLY ESTATE,
SAKLESPUR P.O.,
HASSAN DISTRICT, MYSORE STATE,
February 24, 1958.

K. R. SETHNA

[It is not easy to decide whether these snakes were actually in copulation. Mr. Humayun Abdulali records a similar observation of two Dhamans entwined and apparently mating, which on dissection proved both to be males (*JBNHS* **42**: 666). From a sketch sent subsequently by Mr. K. R. Sethna it appears that in this case also the snakes were entwined round each other. It would be interesting to ascertain by more dissections what exactly is the purpose of these entwinements, whether they represent mating, courtship, or fighting.—EDS.]

17. A NOTE ON THE HILSA FISHERIES OF ASSAM

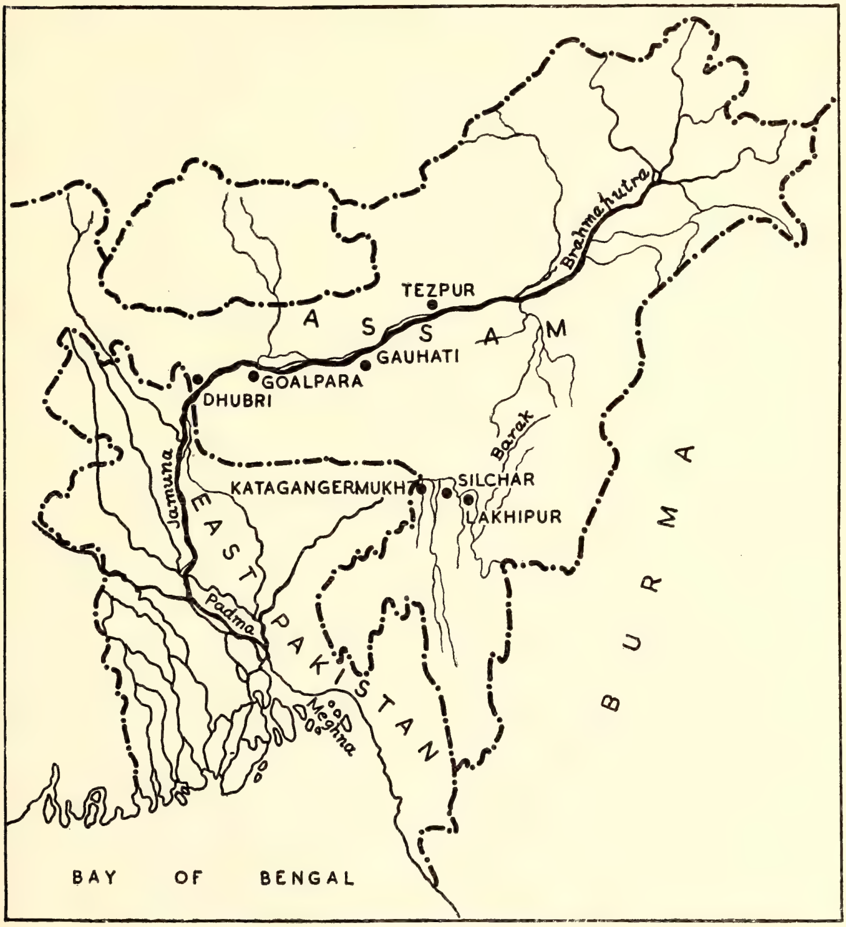
(*With one plate and a text-map*)

The paucity of information on the hilsa fisheries of Assam was brought to light in 1952 when the present status of the fisheries for the species was discussed at a symposium held at Calcutta under the auspices of the Indo-Pacific Fisheries Council [see *J. Asiatic Soc.* (*Sci.*) 20, 1]. But for the passing remarks of Day (1873) and De (1910) about the occurrence of hilsa locally known as *ilihi* in Assam waters, there has so far been no report on the disposition and nature of the hilsa fisheries of the State. A preliminary survey of the fisheries was therefore made by the authors during the hilsa fishing season of 1956. The data collected during the survey are summarised in this note. Grateful acknowledgements are due to the staff of the Department of Fisheries, Assam, for their help and co-operation in conducting the survey.

HILSA FISHING AREAS AND SEASONS

Fishing for hilsa is done in Assam in the rivers Brahmaputra and Barak (see map), larger catches being obtained from the former river. In the Brahmaputra the fishery extends from Dhubri near the border of West Bengal to the neighbourhood of Tezpur in the upper reaches, covering a distance of about 190 miles. During years of abnormal abundance of hilsa, as in 1955, they are caught in areas further upstream also. In the Barak, hilsa fishing is done in an area extending from the neighbourhood of Lakhipur to Kataganger-mukh, a distance of about 45 miles. In both these rivers the water is entirely fresh throughout the year, but in the Brahmaputra near Dhubri it is reported that the tidal effect is sometimes felt during the dry months. The major fishing centres are located near the consuming centres and the concentration of fishing units seems to be largely dependent on the facilities for marketing the catches, but when catches are poor in an area the fishermen migrate to areas where better fishing can be had.

Fishing rights in the Brahmaputra are mainly owned by private landlords or religious institutions who lease out the rights for fishing in different zones to lessees. The lessee, or sub-lessee when the rights are sub-leased, levies a fishing permit fee for every month or season of fishing. The ownership of the fishing areas in Barak River rests with the State and portions of the river are leased out to private parties who may sub-lease it to others or give permits directly to fishermen to fish in the area.


Brahmaputra
TEZPUR
A S S A M
GAUHATI
GOALPARA
DHUBRI
Barak
SILCHAR
KATAGANGERMUKH
LAKHIPUR
Jamuna
EAST PAKISTAN
Padma
Meghna
BURMA
BAY OF BENGAL

Map of Assam showing the location of the Hilsa fishing areas.

The hilsa fishing season in Assam extends from about the middle of April to September. In the lower reaches of the rivers generally fishing starts by about the middle of April, whereas in the upper reaches it starts only by May or June. The peak period differs for each centre, but is generally between July and the middle of September. There is no organised hilsa fishing during the winter months in the rivers of Assam as in the Sundarbans (West Bengal), but young hilsa are reported to be caught in small numbers in areas near Dhubri, Goalpara, Gauhati, and Tezpur.

During the season, fishermen from several villages in Assam migrate to hilsa fishing centres, where they remain for the whole season. The number of fishermen engaged in hilsa in the State has increased considerably in recent years on account of the influx of displaced fishermen from East Pakistan.

FISHING METHODS AND DISPOSAL OF CATCHES

The most commonly used fishing implement for hilsa in the Brahmaputra is the clap net known as *sanglo*, which is also widely employed in West Bengal (Naidu, 1939). Large boats known as *pansi nauka*, measuring about 30′×6′×2½′, are generally employed, and from these two *sanglo* nets are operated at a time, while from smaller boats known as *kosa nauka* measuring about 24′×4′×1¼′ only one net is operated (plate, fig. 1). *Sharki jal*, another clap net operated in Dhubri and Goalpara areas of the Brahmaputra, is very similar to the *sanglo*, but differs from it mainly in that instead of a rope, a bamboo pole tied to the lower rim of the net mouth is used to keep the net open and for closing it. *Firki jal* or *hafa jal*, which is also known as *chirong jal* is the most commonly used hilsa fishing implement on the Barak. It is also operated in Goalpara and Tezpur areas along the Brahmaputra where it is known as *garua ilihi*. It is a triangular dip net measuring about 16′ at its base, mounted on a bamboo frame with the two arms measuring about 18′ and operated from the bow of a boat (plate, fig. 2). The maximum depth of the bag formed by the net is about 10′ and the mesh measures about 3″. Only one such net can be operated from a boat at a time. In Tezpur area along the Brahmaputra a wide mouthed cast net known as *garua ilihi* is used for catching adult hilsa from shallow marginal areas of the rivers. During the winter months when the water level in the Brahmaputra goes down, it is reported that *kona jal* and *jaqatber jal* are operated in the neighbourhood of Goalpara and Dhubri and small quantities of hilsa are caught. A complete inventory of the fishing craft and tackle has not yet been made, but on the basis of enquiries made among fishermen and fish merchants, it has been estimated that there were about 2,200 boats operating about 3,500 nets on the Brahmaputra, and 800 boats operating 1,200 nets on the Barak during the hilsa season of 1956. The total landings from these two rivers are estimated to be about 75,000 mds. per year. Fishing is generally done in the Brahmaputra

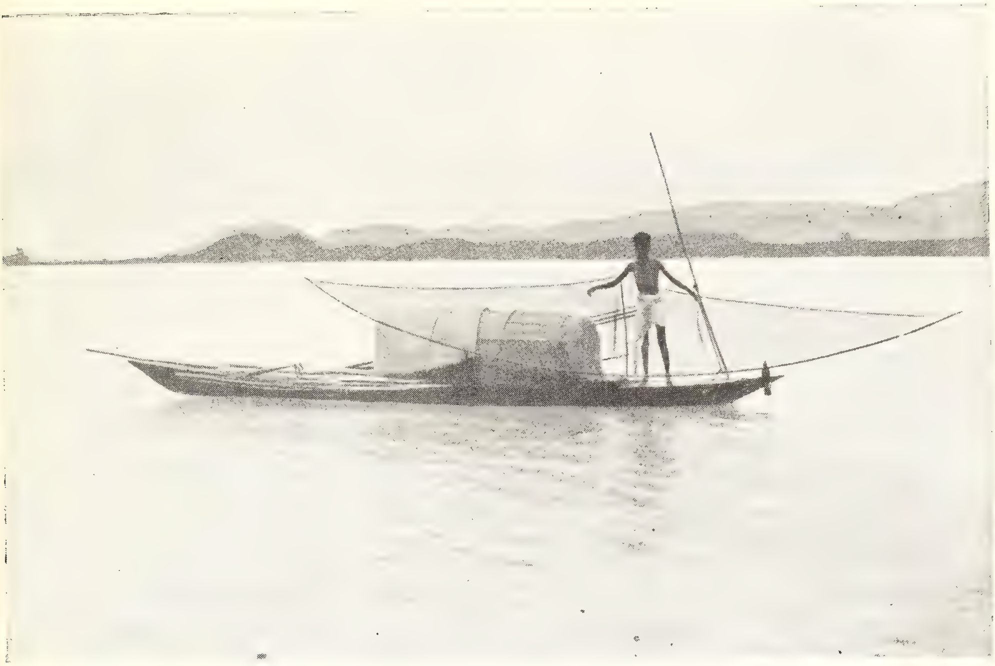


Fig. 1. The clap net *sanglo jal* operated from *kosa nauka* in River Brahmaputra.

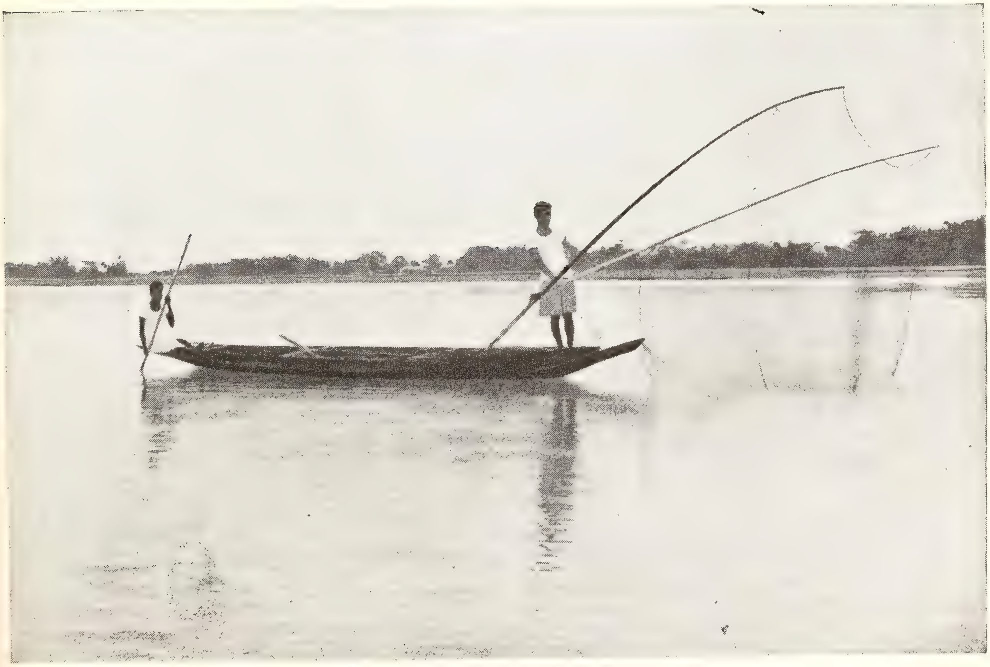


Fig. 2. The *firki jal*, also known as *hafa*, *chirong*, and *garua ilihi*, commonly used for hilsa fishing in the Barak.

from the early hours of the morning to late in the evening but in the Barak, which is a small river, fishing is done both during day and night. The catches are sold to fish merchants who wait at the landing places. As very few of the fishermen in the area take loans from fish merchants, they are able to sell their catches to the merchants at a reasonable price. The price of hilsa, especially when river-fresh and not preserved in ice, is often very high near consuming centres like Gauhati. Even though the magnitude of hilsa populations in the rivers of Assam is not known, it would appear from the available information that there is scope for intensifying hilsa fishing in the rivers. At present fishing is done mainly in the neighbourhood of consuming centres. If better facilities for transport of catches can be arranged, it may be possible to persuade fishermen to fish in areas not exploited at present.

BIOLOGICAL NOTES

As can be seen from the map, the river Brahmaputra continues as the Jamuna in East Pakistan and joins the Padma. River Barak joins Meghna in East Pakistan. Morphometric studies of samples of hilsa from Brahmaputra and Barak (by one of us) have shown that the stocks of hilsa in these two rivers are different[1]. Whether they are homogeneous with the hilsa stocks of East Pakistan rivers has yet to be ascertained. Examination of catch samples showed that the fish are all in maturing or mature condition. A number of them were in oozing condition and even though no fertilized eggs or larvae were collected from these areas, it appears that they breed in the area as young ones are reported to be caught in fair numbers in small-meshed nets when the water level goes down.

The length-frequency data of commercial catches of hilsa from Brahmaputra and Barak, examined during the survey in the month of July '56, showed that fish measuring 36 to 37 cm. in length formed the majority group in both the rivers, which on the analogy of the hilsa of the Hooghly may be considered to be about 3 years old (Pillay, 1957). Other size groups are not quite prominent in the samples, except for one with a mode between 39 and 40 cm. in the catches from the Barak.

CENTRAL ISLAND FISHERIES RESEARCH STATION,
CALCUTTA 7.
November 11, 1957.

T. V. R. PILLAY
A. N. GHOSH

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[1] A detailed account of these studies will be published elsewhere.

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Day, F. (1873): Report on the fresh water fish and fisheries of India and Burma, Calcutta.

De, K. C. (1910): Report on the Fisheries of Eastern Bengal and Assam, Shillong.

Naidu, M. R. (1939): Report on a survey of the Fisheries of West Bengal, Calcutta.

Pillay, T. V. R. (1957): The biology of the Hilsa, *Hilsa ilisha* (Hamilton), of the River Hooghly. (In Press).

18. 'AN INDIGENOUS FISHING ROD AND TACKLE'

I am interested to read the note and see the text figure at page 953 of Vol. **54**, No. 4. When at Secunderabad in 1899-1903 and again in 1906 I fished from the bund of the Hussain Sagar Lake using a short bamboo rod with whalebone tip, or was it buffalo horn? I always called it whalebone; and it was not easy to obtain.

My short rod had not the nicety of a hole drilled through the butt. The line was secured to the butt of the bamboo by means of a clove-hitch, and then passed to the tusser silk loop at the rod tip.

The rest of the technique was as in the note. Fish taken were mostly rohu up to about 15 lb.; and though I had the place baited with balls of ragi I never got any larger fish. My experience was that the whalebone tip is superior to the use of the peacock quill float I had used before going to Secunderabad.

C/o LLOYDS BANK LTD.,
39, PICCADILLY,
LONDON, W. 1.
February 16, 1958.

R. W. BURTON
Lt.-Col., I.A. (Retd.)

19. 'CROP PESTS AND THEIR CONTROL IN THE PANJAB'

I am afraid that I cannot allow Dr. K. N. Trehan's paper under the above title (1957, *JBNHS* **54**: 581-626) to escape without very severe criticism, so far as the Lepidoptera is concerned. I am not in a position to comment on the other groups.

In the first place the text figures are unrecognisable; to put it mildly, not only are the markings shewn wrongly but the general outline has no resemblance to the actual insect. Also, in many cases, the scale is wrong. Compare Fig. 13 (*Prodenia litura* F.) with Fig. 139 from Hampson's FAUNA OF BRITISH INDIA, Moths, Vol. II, for example. Would anyone think that the two figures depicted the same insect? Fig. 8 (*Earias insulana* Bsd.) is not symmetrical, the apex of the left forewing is truncate, that of the right produced. Fig. 10b (*Achaea janata* L.) is said to be to scale x 1¼. The wing expanse of the figure is 40 mm., i.e. actual size 32 mm. Hampson, in the

CATALOGUE OF THE LEPIDOPTERA PHALAENAE, gives the wing expanse as 52 to 70 mm., and all the specimens that I have seen have been nearer the top figure. Fig. 33 (*Virachola isocrates* F.) shews a venation that is completely unknown in the Rhopalocera, no cell and all the veins arising from the base of the wing. If a paper is to be illustrated by text figures they should not be grossly misleading.

The text is also full of errors.

P. 591. Is the 'Lahni' moth really *Utetheisa pulchella* L.? I know the species is easily identifiable, but the usual food-plants of *Utetheisa* belong to the Boraginaceae. *Crotalaria* is the food-plant of *Argina cribraria* Clerck.

P. 592. *Euproctis lunata* Wlk. and *E. fraterna* Moore do not pupate in the soil but spin small cocoons affixed to leaves or twigs in which they pupate. *Achaea janata* L., also, does not pupate in the soil but, like all the Catocalinae known to me, spins a slight cocoon between leaves.

P. 593. *Amsacta moorei* Btlr., not Butt., and Arctiidae not Arctiadae. I have no personal experience of this species but I am very doubtful of any of the Spilosominae pupating in the soil; I would expect it to pupate in cocoons spun amongst litter on the surface of the soil or possibly under stones or clods of earth.

P. 597. *Amsacta moorei,* again Btlr., not Butt.

P. 598. „ „

P. 599. „ „

P. 599. *Cirphis unipuncta,* Haw. not 'N'.

P. 601. *Amsacta moorei,* again Btlr., not Butt.

P. 603. *Pieris brassicae* L., not *brassica.*

P. 606. *Heliothis,* not *Heliothes.* An identification open to very considerable doubt.

P. 611. *Pieris brassicae* L., not *brassica.*

P. 613. *Malacosoma indica* Wlk., this belongs to the Lasiocampidae.

P. 616. *Parasa* sp., this belongs to the Limacodidae and larvae should not be handled as they sting.

P. 616. *Cacoecia,* not *Cocoecia,* belongs to the Torticidae.

P. 620. *Euproctis,* not *Euprocitis.* *Lunata* are pale, bright what?

P. 620. *Herse convolvuli,* not *Heise.* I am rather dubious about this species and also *Acherontia styx* Westw. (not 'W') attacking Vines. Bell & Scott do not include *Vitis* in the long list of food-plants given for these species. To me it seems more likely that the species concerned would be one of the Choerocampinae, say *Hippotion celerio* L. or a *Theretra* species.

P. 621. *Papilio demoleus* L. Dr. Trehan makes no mention of *Papilio polytes* L., which is equally common and has the same food-plants and habits. To a non-entomologist, the larvae of the two species are almost indistinguishable.

Dr. Trehan is, presumably, following Hampson in his use of the family name Pyralidae. Nowadays Hampson's subfamilies are given family status, i.e. Crambidae, Schoenobiidae, Phycitidae, etc.

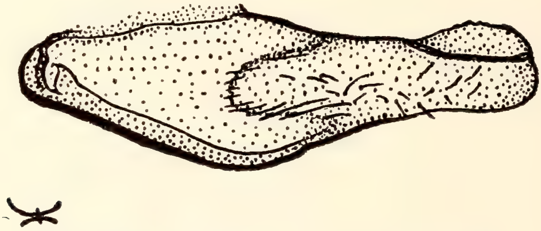
MOMBASA, D. G. SEVASTOPULO, F.R.E.S.
November 12, 1957.

20. A NEW BUTTERFLY FROM ASSAM

(*With a text figure*)

Ypthima cantliei sp. nov.

Four males of this very distinct species were taken by me on 12th and 15th April 1957 near Margherita in Upper Assam. They were caught at plains level in scrubby bamboo jungle near the point where the Dirok River enters the hills, flying in company with *Y. ceylonica hübneri, Y. nareda,* and *Y. baldus.* Y. cantliei appears to be closest to *Y. ceylonica* Hewitson, from which it may readily be distinguished by the greater size, the coarse dark striation of the underside, and the very different clasp of the genitalia.



Inside view of right clasp of *Ypthima cantliei.*

Specimens from the type series will be presented to the Zoological Survey of India, Calcutta, and to the British Museum (Natural History), London.

DESCRIPTION

♂. Antenna brown, narrowly ringed with white at joints, club chestnut; head thorax, and abdomen brown.

Upperside: Fore wing. Ground colour brown, without brand; an ill-defined dark discal line and a prominent dark subterminal line present; a bipupilled apical ocellus obscurely ringed with yellow, the upper pupil being placed nearer to the apex than in other species of this genus; length from base to apex 21 mm.

Hind wing. Ground colour as fore wing but becoming lighter in outer third, where there are a few striations; discal and sub-terminal lines as on fore wing, the former sharply angled outwards opposite end of cell; three yellow ringed single-pupilled ocelli in tornal area, prominent in spaces 2 and 3 but minute in space lc.

Underside: Fore wing. Ground colour greyish white, evenly and densely covered with coarse dark brown striations; faintly marked discal, post-discal and sub-marginal dark bands; a large yellow-ringed bipupilled ocellus at the apex.

Hind wing. Ground colour as fore wing. One apical and three tornal yellow-ringed ocelli, subequal and one-third the size of fore wing ocellus; all single pupilled excepting the ocellus in lc which is bipupilled; the three tornal ocelli in a straight line.

Cilia brown.

Genitalia: The valve is short and broad, in the fresh specimen terminating in the shape of a spoon. In the dried specimen the valve appears of equal width throughout due to two flaps being raised medially.

It is a pleasure to name this species for Sir Keith Cantlie C.I.E., I.C.S. who is doing such valuable work on problems connected with the taxonomy of Indian butterflies, and without whose help, together with that of Mr. T. G. Howarth of the Department of Entomology, British Museum (Natural History), this species would not at present have been elucidated. I am deeply indebted to Mr. Howarth and Sir Keith Cantlie for ascertaining that no other species in the British Museum collection has an exactly similar facies; and to Mr. Howarth for preparing a slide of the genitalia and the figure of the clasp.

SELENG T.E.,
SELENG HAT P.O.,
UPPER ASSAM,
February 19, 1958.

T. NORMAN

21. NOTES ON THE BIOLOGY AND CONTROL OF *BRITHYS CRINI* FABRICIUS

The joint authors of the note under the above heading (1957, *JBNHS* **54**: 784) are wrong when they state that the species is not even mentioned in Hampson's FAUNA OF BRITISH INDIA. It is described, and also figured, and the larva is also described, but under its old name of *Glottula dominica* Cr. It is also described, again under the old name, and both the imago and larva figured in Moore's LEPIDOPTERA OF CEYLON, Vol. III.

I do not think that the control measures suggested would be altogether successful as the newly hatched larvae bore into the leaf tissue and eventually find their way into the bulb, they do not feed on the surface of the leaf until after the 4th instar. Incidentally, the very high larval mortality in the first instar was probably due to unnatural conditions in the laboratory.

There are two other serious pests on Amaryllidaceae in Calcutta, *Polytela gloriosae* F. and *Calogramma festiva* Don, both of which feed on the surface of the leaf from the time of hatching, and which would respond more readily to the control measures suggested.

MOMBASA,
November 13, 1957. D. G. SEVASTOPULO, F.R.E.S.

22. 'AN EPISODE FROM THE LIFE-HISTORY OF THE MOTH *SUANA CONCOLOR* WLK.'

With reference to the note under the above heading (1957, *JBNHS* **54**: 784), I have records of the following food-plants:

Careya arborea (Myrtaceae).
Litsaea polyantha (Lauraceae).
Shorea robusta (Dipterocarpaceae).

I have not bred the species myself but, like so many of the Lasiocampidae, it appears to be a fairly general feeder.

With regard to the efficiency of the insect as a 'flying machine', I think it extremely doubtful that any of the larger Lasiocampid females indulge in really sustained flight until a fair proportion of their eggs have been laid.

MOMBASA,
November 11, 1957. D. G. SEVASTOPULO, F.R.E.S.

23. A NOTE ON THE DIAGNOSTIC FEATURES OF LARVAE OF *ANOPHELES VARUNA* IYENG.

(*With three text figures*)

Puri (1931) originally described the larvae of *Anopheles varuna* basing his observations on specimens collected from south India. Roy (1938) noted certain differences in the larvae of the same species from Bengal and pointed out that 'The antero-internal clypeal hairs of the larva . . . show a constant fraying. The thoracic palmate hairs have the ends drawn out and in this respect also these larvae differ from those of *varuna* which resemble *minimus* in having their ends truncate.' On the basis of these differential characters Roy held that the *varuna* of Bengal represented a new variety.

While a constant fraying of 'antero-internal' or inner clypeal hairs in *varuna* larvae, as noticed by Roy, was at variance with what Puri (1941) had described as primarily simple with some fraying in a few, the second character about the 'drawn out' thoracic palmate hairs in *varuna* from Bengal was in fact a reassertion of what Puri had also observed (p. 155). Roy somehow missed this point in Puri's description. In this character therefore the two larvae from the South and Bengal do not show any difference.

According to Venkat Rao and Ramakrishna (1940) the *varuna* larvae from Waltair and Gopalapatnam (Madras coast) also have inner clypeal hairs branched in 98 per cent of the specimens observed, while the outer and the posterior clypeal hairs were invariably simple. In the larvae from Bhadrak (Orissa), on the other hand, not only the inner clypeal hairs were branched as in Waltair specimens, but the other two sets of clypeal hairs, 56 per cent of the outer and 0.7 per cent of the posterior, were also branched.

I have recently examined a large number of larvae of *varuna* from Bengal (collected from different places), and the observations made have been given in Table 1. These observations show that

TABLE 1.

Morphological characters of *varuna* larvae from Bengal.

		Actual number showing the character	Percentage
Head Pattern ..	Blotching 'Y' shaped.	17	23.0
	Blotching 'U' shaped.	16	21.6
	No blotching.	41	55.4
Inner clypeal hairs ..	Frayed.	56	75.6
	Not frayed.	18	24.4
Outer clypeal hairs ..	Frayed.	11	15.0
	Not frayed.	63	85.0
Posterior clypeal hairs ..	Frayed.	4	5.4
	Not frayed.	70	94.6
Inner sutural hairs ..	4-7 branched.	73	99.0
	2-3 branched.	1	1.0
Outer sutural hairs ..	4-7 branched.	71	96.0
	2-3 branched.	3	4.0
Thoracic palmate hairs ..	14-22 leaflets.	72	97.0
	11-13 leaflets.	2	3.0

the anterior clypeal hairs were branched in about 75 per cent of the larvae examined. The percentage of larvae showing frayed inner clypeal hairs was not as high as in the specimens from Waltair (Venkat Rao and Ramakrishna, loc. cit.) or as observed by Roy (loc. cit.). Such fraying of inner clypeal hairs has often been observed as a variation from normal in a number of species. The mere presence of branching in the clypeal hairs further does not warrant splitting of the species into varietal forms, especially as the adults emerging from these larvae have all the characters of typical *A. varuna.* Opposing the idea of creating a new variety on the basis of this variation, and in order to avoid complications, Venkat Rao and Ramakrishna (loc. cit.) suggested certain amendments to the original description to include this branched condition of the inner clypeal hairs. The amendments suggested by these authors have not proved very informative. In view of the above position, therefore, I have suggested the following alterations in the revised synoptic table given below for distinguishing the larvae of the *funestus* group in Bengal:

Revised Key.

1.	Anterior clypeal hairs with barb-like branches: Posterior clypeal hairs frayed from base (Fig. 1)	*aconitus*
	Anterior clypeal hairs may or may not show fine branches: Posterior clypeal hairs simple, branching if present (5%) is an exception	(2)
2.	Presence of a pair of minute hairs, one on each side in the anterior tergal plate of certain abdominal segments (Fig. 2) ..	*varuna*
	The pair of minute hairs arises outside the tergal plate; these when relatively better developed	*fluviatilis*
	When these hairs are poorly represented (Fig. 3).. ..	*minimus*

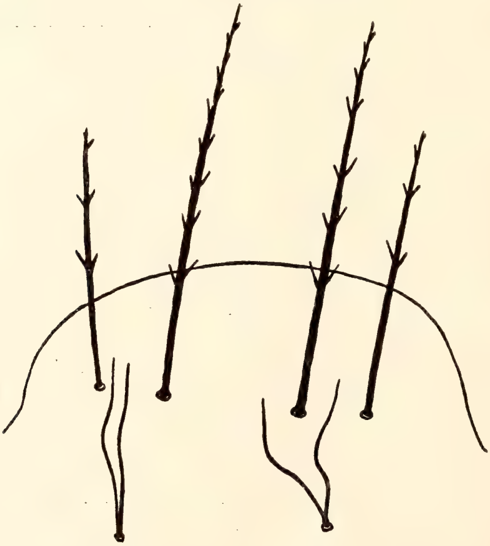


Fig. 1. × *ca.* 290

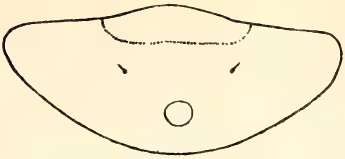


Fig. 2. × 100

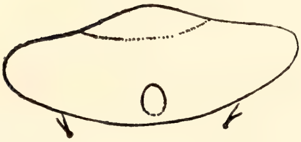


Fig. 3. × 100

School of Tropical Medicine,
Calcutta,
December 20, 1957.

P. SEN

REFERENCES

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— — (1941): Health Bulletin, No. 16, p. 101.

Roy, D. N. (1938): A note on the larva of *A. varuna* Iyengar. *J. Mal. Inst. India* **1**: 269-272.

Venkat Rao & Ramakrishna, V. (1940): A note on the larva of *A. varuna* Iyengar. *J. Mal. Inst. India* **3**: 509-512.

24. FLOWERING OF *STROBILANTHES*

I am very interested to find that the flowering of the hillside grass *Strobilanthes kunthianus,* which blooms and dies once in twelve years, has coincided this year with the flowering of *Strobilanthes* species in the evergreen sholas, blooming and dying once in seven years, on the Billigirirangan Hills, S. India. Such combined flowering must be rare. The results were beautiful.

Dupabarray Bungalow,
Attikan P.O.,
Via Mysore, South India,
February 6, 1958.

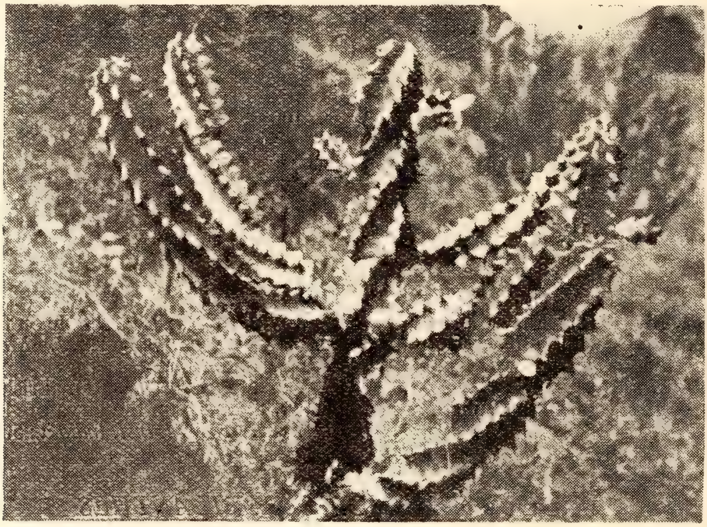
R. C. MORRIS

[A few years ago the Bombay plant, *Strobilanthes callosus* or *Carvia callosa,* produced one of the general flowerings which also coincided with several other species of *Strobilanthes* in an area from Mt. Abu in Rajputana to the Nilgiris and Palnis in S. India. The period between any two general flowering seasons for many of the species of *Strobilanthes* varies between 7 and 12 years, but our information is rather scanty on the subject. See Santapau in *Bot. Mem. Univ.*

Bombay **2**: 47-50, 1951 on authenticated general flowering of several species of the genus.—EDS.]

25. THE PHYLLOTAXY OF *EUPHORBIA NERIIFOLIA* LINN.

In a recent outing to Purandhar, Poona district, we have had occasion to study large numbers of *Euphorbia neriifolia* plants, and had our attention strongly called to the strange behaviour of the leaf or leaf scars on the stems and branches.



Each leaf is accompanied by two stout stipular thorns, which persist even after the leaf has disappeared; the leaf scar, showing the point of attachment of the leaf to the plant, is a clear whitish areole between the stipular thorns. In this plant it is quite easy, even in the absence of the leaves, to determine their position on the stem or branches, in other words, their phyllotaxy. Further, on most plants, particularly the younger ones, the leaves and thorns are borne on a prominently raised ridge or wing-like structure that remains quite evident in all but the very oldest plants; in these the ridge may become somewhat flattened, and the stem thereby becomes more or less terete or round in section.

In most Phanerogams generally the phyllotaxy or arrangement of the leaves is quite a constant character, so constant in fact that use may be made of it for the purposes of classification. Apart from the phyllotaxy, which is constant, some climbers show marked preference for a definite direction in their turning or twisting round their supports and, where this is the case as in *Dioscorea,* this becomes an important detail for classification. But a careful reading through the standard works on the subject has failed to reveal any mention of the phyllotaxy *twisting to the right and to the left on one and the same plant.* This is why the behaviour of *Euphorbia neriifoli*a attracted our attention.

Shortly after visiting Purandhar, the senior author went to Khandala, on the Western Ghats, and carefully studied *Euphorbia neriifolia* Linn. and noted the same strange behaviour which had been observed in Purandhar.

The following are the common arrangements of the leaves in *Euphorbia neriifolia* as shown either by the leaves themselves or by the stipular thorns and leaf scars.

1. On rather old stems, the stipular thorns were placed in practically vertical rows without any noticeable deflexion to either side; the ridges or wings were nearly flat, and the stems were practically circular in transverse section. Most of the older plants, reaching the size of small trees, showed this arrangement both on the main stem and on the branches.

2. Some other plants had their stipular thorns forming usually five strong spirals twisting from left to right from below upwards, i.e. going counter-clockwise; other plants had the spirals twisting from right to left from below upwards, i.e. going clockwise. Either direction in the twisting could be noted, but the stems and all the branches had a constant direction in the twisting of the spirals. This arrangement was noted as rather rare in *Euphorbia neriifolia.*

3. In most of the younger plants examined, it was noted that whilst the stems might show a left to right spiral, some of the branches of the same plant showed twisting from right to left; or alternatively the stem showed right to left spirals, the branches left to right. This double arrangement on one and the same plant was noted in practically all young plants, that is to say in plants up to 1 m. high. Both of us and a group of senior students in our company examined well over 100 specimens in the field, and noted this double phyllotaxy in most of the plants.

This double twist is well shown in the accompanying photograph, which is reproduced from a Kodachrome slide made by the senior author in Purandhar. In the photograph the main stem in the middle shows left-right spirals; the lowest branch at the right follows the same direction as the main stem; but the next two branches on the right show twisting in the other direction; the two branches on the left-hand side show right-left twisting. The actual plant in the photograph was about one meter in height.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
November 15, 1957.

H. SANTAPAU, S.J., F.N.I.
G. L. SHAH, M.SC.

26. THE COCONUT, *COCOS NUCIFERA* LINN.

OBSERVATIONS OF THE FIRST ENGLISH JESUIT IN INDIA

Father Thomas Stephens, the author of *The Christian Purana,* was born in 1549 at Bushton, in Wiltshire; he entered the Society of Jesus in Rome in 1575; he sailed for India from Lisbon on April 4th, 1579, and landed in Goa on October 24th of the same year. He was the first English Jesuit to set foot on Indian soil, though he was not the first Englishman to come to India; already in 1546 two Englishmen took part in the defence of the besieged harbour-town of Diu. Fr. Stephens died in 1619.

His observations on the coconut palm are given in a long letter to his brother Richard, at the time a professor in Paris; the letter is dated October 24th, 1583 and is written in Latin. This is not the first or oldest mention of the palm-tree by European authors; already Garcia d'Orta mentioned it in his *Coloquios* published in 1565; C. L'Escluse in 1567 summarized d'Orta's notes on the subject in his *Aromatum and Simplicium . . . Historia,* chapter 26. The remarks of Fr. Stephens, however, may be of interest to our readers, and for this reason the text is here given in the original Latin with a free translation. Fr. Stephens's letter has been lately published by G. Schurhammer in *Archiv. Hist. Soc. Jesu* (**26**: 71-77, 1957).

Fr. Stephens' text is as follows: 'Est apud nos arbor non rara, sed ulmis et vitibus frequentior, palma dicta a similitudine et fortasse vere palma, si palmae nomen esse genericum et duas sub se species continere concesseris. Haec oleum dat, et vinum, lac et mellis saccarum, nec non et acetum, chordas etiam ad ligandum, et frondes, quibus pluviae a tuguriis arcentur. Fructus habet perennes, non dactylos, sed nuces potius instar humani capitis, quae detracta lanugine, quae extrinsecus est, duorum pugnorum magnitudinem exaequant. Intus habet aquam tenuis cerevisiae similem, ad sitim sedandam non ineptam, eamque tam copiosam, ut una exhausta aliam plerumque non desideres. Nuci intrinsecus adhaeret tamquam caelum undique claudens albugo, qui cibus est non contemnendus. Hinc faber ferrarius carbones petit. Hac, qui in maritimis locis habitant, navigia non solum onerant, sed etiam compingunt cum velis et funibus aliisque requisitis. Literas vix alias reperies, quam quae in harum foliis descriptae sunt. Non alio tegumento, qui terram colunt, ad pluvias arcendas fere utuntur.'

This may be freely translated thus: 'In this country there is a common tree, more common than elms and vines in other countries, the so-called palm-tree, which looks like and is perhaps truly a palm-tree, if you are ready to admit that the name "palm-tree" is a generic one with two species. This palm-tree yields oil, wine (or toddy), milk and honey-sweet sugar, and even vinegar; in addition it is used for the making of cordage and its leaves for the thatching of cottages to keep out the rain. It bears fruit throughout the year, not dates, but rather nuts like a man's head; stripped of the outer fibrous covering, the nut is about as large as two fists put together. Inside it has a liquid which is like light beer and is a refreshing drink; this is so abundant that after drinking the contents of one nut, you scarcely feel the need of another. The inside of the nut is lined with a white substance, which is quite tasty to eat. From the nut the village blacksmith gets his charcoal, whilst those who live along the sea shores transport to other places not just full shiploads, but mountains of the nuts stacked high round the sails, the cordage, and other fittings of the ship. Besides, the letters which people send to one another are nearly always written on the leaves of this palm-tree; further, labourers working in the field scarcely use any other protection against the rains.'

ST. XAVIER'S COLLEGE,
BOMBAY 1, H. SANTAPAU, S.J., F.N.I.
November 11, 1957.

27. EXPORT OF ANIMALS FROM INDIA

According to the office of the Chief Controller of Imports and Exports, Ministry of Commerce and Industry, New Delhi, live animals of the following value were exported from India between January and June 1957.

Monkeys	Rs. 40,15,284
Birds	3,50,515
Bulls	9,000
Dogs	81,294
Elephants	59,780
Tigers	10,646
Cows	8,000
Buffaloes	43,100
Others	1,17,795
Total ...	Rs. 46,95,414

114, APOLLO STREET,
BOMBAY 1, EDITORS
January 10, 1958.

Gleanings

Carbonic Acid kills Whales in two seconds

A new Norwegian invention for hunting whales using carbonic acid (H_2CO_3) will now be tried out in practice in whale hunting around Iceland. The new idea, experimented with by the Norwegian engineer C. U. Wetlesen, is that when the harpoon hits the whale the shell releases 2.5 cu. metres of carbonic acid, which spreads through the whale's body and kills it in two seconds. It then causes the whale to float up to the surface without air having to be pumped into it, as is the present method.

'Norway Press Bulletin' (*No.* 30/1957).

(From Government of India, Ministry of Education and Scientific Research, Department of Scientific Research and Technical Education, Science Newsletter No. 321 dated 29 November 1957.)

EXTRACTS FROM THE MAMMALS OF CHINA AND MONGOLIA PART I, BY J. A. ALLEN. Natural History of Central Asia, Vol. XI. Published by the American Museum of Natural History, New York 1938.

Hedgehogs, *Erinaceus europaeus dealbatus* 'are looked upon as sacred animals by the Chinese and so are not molested, but on the contrary, little shrines are often built for them. This may in part account for their comparative abundance in parts of this province (Hopei), for elsewhere they are often eaten, and Sowerby recounts that in Manchuria the woodsmen prepare them for eating by first encasing them in a coating of mud, which, after the animal has been roasted whole in the embers of a wood fire, comes away with the spines, hair, and skin adhering to the clay, 'leaving a very toothsome morsel of beautifully cooked meat'. He adds that foxes often kill hedgehogs by thrusting their snout under the spiny ball, and throwing the animal into the air. 'This makes the hedgehog uncurl, and, before it can curl up again, the fox has nipped it in the unprotected vitals.' (*Pages* 51 *and* 52.)

Tylonycteris pachypus fulvidus (Blyth). 'The usual hiding place of this little bat during the day is in hollow bamboo stems, and Mell records that he once took thirteen from a bamboo joint split on one side in the midst of forest, and had on four other occasions obtained from three to five specimens in similar situations . . . Its very much flattened head is perhaps an adaptation allowing it to enter narrow cracks and so to obtain access to the hollow interior of bamboo stalks, while the obvious pads under the thumbs and soles of hind feet perhaps are useful, as Dobson long ago suggested, to enable it to cling to the smooth sides of such places.' (*Page* 248)

[The range of this bat as given by Ellerman & Scott (1951, p. 175) is: Sikkim, Manipur, Chin Hills, Shan States, Pegu, Tenasserim, Yunnan, Laos, Tonkin, Annam.—EDS.]

Scotophilus temminckii consobrinus J. A. Allen. 'On April 18 a large number, estimated at about one hundred, were found among the dead hanging leaves of a palm tree in the mission compound; eighteen of them were shot and all proved to be females. Later, on June 9, this colony was found to have increased to large size and several hundred were killed. They had sought refuge under the drooping leaves of the palm. All of those examined proved to be adult females, most of them with young. Many of the latter were still hairless but others were already well covered.' (*Page* 255)

[This race occurs in S. China, Hainan, and Formosa. Its Indian representative is *S. t. wroughtoni* Thomas—W. India and Ceylon.—EDS.]

The Himalayan Marten, *Charronia flavigula flavigula* (Boddaert). 'Mell (1922, p. 17), writing of Kwangtung, tells of two that were shot on the edge of an opening in the woods in early morning as they were snapping at bees going in and out of a hive; their stomachs contained the bees they had already caught. A male shot October 15 in a high tree in a village wood at Fungwahn, also had honey bees in its stomach, so that these are evidently a favourite food. Indeed, Sowerby (1923) states that it is known in Manchuria as "mi-kou" or Honey Dog, although in Shansi and Shensi the Chinese call it "hwangyao" (Yellow Marten), in reference to its yellow colour. A writer in the *Journal of the Bombay Natural History Society* (1916, Vol. 24, p. 589) has mentioned its fondness for nectar, and another speaks of its running down fawns of the Barking Deer. Evidently its predaceous habits of diet are modified by a liking for sweets, but of its special animal food there seems to be little recorded for China.' (*Page* 367)

[Range: Kashmir to Tibet and Southern China, north to Shensi, Kansu.—EDS.]

EXTRACTS FROM I.U.C.N. BULLETIN SELECTED AND ANNOTATED BY R. W. BURTON, Vol. VI, No. 5 (November 1957)

A Case for the Crocodile

Marginal to the editorial in the above we have in about 1,200 words ample reasons for the re-appraisal of Man's attitude towards the crocodiles of Asia and Africa and the alligators of the American continent.

> 'Numbers are reducing in Madagascar, and over large tracts of tropical countries these reptiles are no more than a curiosity. On the Island of Mauritius and in Palestine they are but a memory. .... Already Guatemala has decided to pass a law before these reptiles (Alligators and Caymans) completely disappear.

Dr. H. B. Cott, Cambridge:

> 'Non-adult crocodiles feed on insects or nymphs of water insects which would have otherwise destroyed fish spawn. On the other hand caymans of the Amazon, harmless to humans, wage savage warfare on *pirayas*—a meat-eating fish that breeds in lakes—which attacks man and beast once the reptiles, which kept down the numbers, have been killed off.
>
> Near certain fishing grounds, functions resembling those of a policeman are taken on by crocodiles which, by exterminating the cat-fish that terrorise the *tilapias* (a sort of perch) are thus protecting a valuable source of protein . . . *as is often the case with animals of prey, the specially ferocious individuals need to be eliminated without endangering the whole breed.*' (R.W.B. italics.)
>
> 'There is no doubt that it would be regrettable were the crocodile to disappear; that it is high time more detailed studies were made of its biology and ecology; that, as it is the duty of authorities to provide protection for their inhabitants against its misdeeds, it is equally right to preserve this animal in sparsely inhabited regions, particularly in national parks and reserves and, where necessity arises, to regulate its capture and slaughter.'

Definitions

The Director General of Nature Conservancy in Great Britain (Dr. E. Max Nicholson) gives definitions of some terms in current use by nature protectors.

> *Ecological research* means studying the relations of plants and animals to their environment and to one another.
>
> *Nature conservation* means ensuring by ownership of control and by suitable management that the natural fauna and flora survive and flourish together with the rocks, landscape features, soils, and water on which they depend.
>
> *Nature reserves* are areas which serve either as outdoor living museums for nature conservation or as open air laboratories for ecological research, or both.

. . . To really manage an estate . . . is the conservation of nature based on ecological research aiming at keeping the country worth living in for all its living creatures, including people.

Use of Bats

'Experiments have proved that every night a bat apparently consumes a quantity of insects proportional to about half its own weight.'

Vol. VI, No. 6 (December 1957)

Pesticides

The Assistant Secretary for the Interior for Fish and Wildlife, Washington, has recently emphasised the need for a comprehensive study of the effect of the use of pesticides on the valuable resources represented by wildlife. . . . 'It is essential that investigations should be conducted both in the laboratories and in the field in conjunction with the Forest Service.'

The retired head of the ornithological department of the American Museum of Natural History (Dr. R. C. Murphy) 'has published a sharp attack on the use of D.D.T. with photographic proof of the death of birds as a result of diet of poisoned insects, and a photograph of 98 trout and one eel scooped off a brook on the day following a spraying, and points out the danger to human beings of these toxic substances'. . . . Dr. Paul F. Springer, an American Fish and Wildlife Service biologist, has recently published (1957) a short evaluation of the effects of the use of herbicides and fungicides on wild life. . . . 'Dr. Springer attributes part of the responsibility of some of these results to inexcusable carelessness or lack of knowledge in the use of these products.'

In India, users of these products need the guidance and control of the Indian Council of Agricultural Research through the Board of Research and its attendant organizations set up at a special meeting held at New Delhi on the 1st November 1950.

Notes and News

The President of India has awarded 'Padma Bhushan', the third highest civilian honour in the Indian Republic, to Shri Sálim Ali for services to ornithology.

* * * *

The Zoological Society of India is organising the First All-India Congress of Zoology with the object of bringing together all zoologists in the country.

The Congress will be held in Calcutta from 31 October to 6 November 1958.

The last date for submission of papers to be read at the Congress is August 15. Communications should be addressed to the Secretary, Dr. B. S. Chauhan, Zoological Survey of India, Calcutta.

* * * *

Mr. B. N. Ghildyal author of the paper 'On a Botanical Trip to the Valley of Flowers' (*JBHNS* **54**: 365) wishes us to say that his address should have been printed as 'School of Plant Morphology, Meerut College, Meerut. Now at Indian Forest College, Dehra Dun'.

* * * *

Thanks to the Sir Dorabji Tata Trust, the Society is again in a position to offer modest amounts by way of a grant-in-aid for specific pieces of *field work* in natural history. Applications, together with a summary of the nature of the proposed investigation and the applicant's qualifications and competence, should be made to the Honorary Secretary, Bombay Natural History Society, 114, Apollo Street, Fort, Bombay 1.

* * * *

The Zoological Society of India invite reprints of papers from researchers in any branch of zoology published during the three-year period 1955, 1956, and 1957 for consideration for the third award of the Society's 'Sir Dorabji Tata Gold Medal'. One reprint of each publication should reach the President, Zoological Society of India, 34, Chittaranjan Avenue, Calcutta 12, by the 30th of June 1958 at the latest.

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Mammals

The Book of Indian Animals, by S. H. Prater. With many coloured and black and white plates. 2nd (revised) edition. (*In preparation*)

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Game Birds of India, by E. C. Stuart Baker. Vol. III. Pheasants, 1st Edition. **Rs. 20**
(*Price to Members Rs.* 15)

The Book of Indian Birds, by Sálim Ali. With 56 coloured and 22 black and white plates, 5th (new) edition, revised and enlarged. **Rs. 20**
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Fish

Circumventing the Mahseer and Other Sporting Fish in India and Burma, by A. St. J. Macdonald. With coloured and black and white plates. **Rs. 15**
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1958 AUGUST Vol. 55 No. 2

Some Observations on the Fauna of the Maldive Islands

PART III—BIRDS

BY

W. W. A. PHILLIPS AND R. W. SIMS

(*With two plates*)

[*Continued from Vol.* **55** (1) : 10]

INTRODUCTION

The ornithology of the Maldive archipelago is not well known for few collectors or observers have visited the islands. The only previous list of birds was that made by Gadow & Gardiner in 1903 when 24 species were recorded, some of them by sight identification. During the period December 1956 to February 1957 one of us (W.W.A.P.) visited Malé, the capital, and North Malé Atoll when 128 birds were collected and many observations made. This report gives the results of that visit. Specimens representing 39 species are listed (25 of them being new records) and another 17 species (14 new records) were seen by, or reported to, W.W.A.P. Thus the number of birds recorded from the Maldive archipelago is increased from 24 to 63 species. In addition, two new races have been distinguished and described (Phillips and Sims, 1958). The collection has been presented to the British Museum (Natural History).

Lying between Latitude 8°N. to 1°S. and longitude 72° to 74°E. the Maldive archipelago extends over an area of 470 miles from north to south and 70 miles east to west at its widest, with its capital about 400 miles south-west of Ceylon. It is composed of groups of islands and reefs which form an incomplete double chain of 19 coral atolls resting on a submerged mountain range. Depths of over 2,000 fathoms have

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been recorded in the open seas adjacent to the atolls but 20 to 30 fathoms are usual within the reefs. The Maldive archipelago lies between two other archipelagoes in a north to south line. To the north, linked by the island of Minicoy between the 8° and 9° channels, is the Laccadive archipelago, while 300 to 400 miles to the south of the most southerly atoll of the Maldives, Addu Atoll, is the Chagos archipelago.

The climate is tropical being governed by the two monsoons, the South-west Monsoon lasting from about April to August and the North-east Monsoon from approximately October to February. The rain brought by the monsoon winds is ample and is well distributed throughout the archipelago.

The scattered islands forming the atolls are all fairly small and low-lying, being seldom more than six feet above sea-level ; many have swamps and miniature lagoons in their interiors. Over 2,500 of these islands have been counted but less than 220 are permanently inhabited by man. Most of the larger have had coco-nut palms planted in the coral sand amongst the low scrub and succulent-leaved undergrowth, while a few large evergreen trees, mostly introduced, grow around swamps and villages.

The human population, estimated at between 85,000 and 90,000, is chiefly dependent upon fishing for a livelihood (especially for bonito from which ' Maldive fish ' is made) and partly on the manufacture of copra and coir rope from the coco-nut palms. The islanders live almost exclusively on rice and fish but will eat any bird that has webbed, or semi-webbed, feet. Other birds are often snared and kept as ' pets ' for, being strict Moslems, dogs are banned and the children have few toys (although kite-flying is a national pastime). Several specimens in this present collection were brought in by fishermen and others from the more northerly atolls and outlying reefs for sale alive in the market at Malé. Malé Island, situated in North Malé Atoll in the centre of the archipelago, is about one mile long and half a mile wide, with a population of over 8,000 people. Owing to the difficulties of travel in the Maldives most of our observations were made and specimens collected on North Malé Atoll. Additional information was obtained from Mr. Ibrahim Didi who has travelled throughout the Archipelago and, being a reliable observer, a reasonable degree of accuracy can be credited to the identifications of species and to the dates of their arrivals and departures that he has furnished.

Acknowledgements

Grateful thanks are due to the Hon. Mr. Ibrahim Ali Didi, the Prime Minister, who not only made the visit possible but by his thoughtful kindness greatly helped the work and comfort of the expedition ; to His Excellency Philip K. Crowe, the American Ambassador to Ceylon,

and Mr. Norman Costar, C.M.G., the Acting High Commissioner for Ceylon, who facilitated arrangements and contributed in so many ways to the success of the visit. We are indebted also to many friends in Malé and specially to Mr. Ibrahim Didi, interpreter and constant companion, who provided not only the Maldivian names of all birds collected or seen but gave much extremely valuable information on the distribution and movements of the various species. To Mr. William Perera, taxidermist and collector, who accompanied the expedition from Colombo, go thanks for his excellent work in preparing the specimens. Grateful acknowledgement for help and advice is also made to Mr. J. D. Macdonald, British Museum (Natural History), and lastly the contribution made by Mrs. Paddy Phillips, who always cheerfully put up with so many hardships, contributed, more than any one else, to the success of the expedition.

MIGRATION

Knowledge of bird migration in the Maldives is restricted chiefly to the evidence provided by specimens in the present collection, information gathered from Maldivian islanders, and a few personal observations of W.W.A.P. Migration in the Archipelago is represented almost solely by the arrival of comparatively small numbers of non-breeding visitors and stragglers during October to December with the north-east winds ; then, during the following March and April with the onset of the South-west Monsoon, their return northwards. Of the 37 species listed as visitors all but 4 can be placed in this category, two exceptions being non-breeding and the other two breeding visitors. The non-breeding exceptions are two species of the family Procellariidae (a shearwater and *Oceanites oceanicus*) ; these breed in the southern hemisphere during the southern summer and spend their non-breeding months, i.e. from April to October during the southern winter, in the warmer, tropical seas. The breeding visitors are two species of oceanic terns (*Sterna anaethetus* and *S. fuscata*) that, according to local reports, resort to the islands to breed during March, April, and May after which they return to their pelagic life.

Of the 33 species that visit the Maldives 28 represent non-passerine families : 4 Ardeidae, 2 Anatidae, 4 Falconidae, 6 Charadriidae, 10 Scolopacidae, 1 Strigidae, and 1 Apodidae. Apart from their variable numbers these visitors call for little comment. They arrive annually throughout October, November, and December, then return northwards during the following March and April. It is probable that their route to the Maldives passes down the west coast of India, southwards through the Laccadives, then finally to the northern atolls of the Maldives by way of Minicoy. From local reports it appears that most of these species are more common towards the north of the Archipelago than in the south, so it seems that for many the northern atolls of the Maldives are at the southern limit of their range. On North Malé Atoll, situated about midway along the Archipelago, however, many waders, such as *Numenius p. phaeopus*, *Tringa nebularia*, and *Arenaria interpres*, are common throughout the northern winter.

Although the passerine migrants are few in number, five species representing only two families (Hirundinidae and Motacillidae), they are the more interesting of the non-breeding visitors. The pattern of migration is largely the same as that of other visitors in dates of arrival and departure, but the migration is on a smaller scale with greater fluctuations in numbers. During the period of the visit by W.W.A.P. swallows (*Hirundo rustica gutturalis*) were frequently observed with the maximum of three seen in one day. The House Martin (*Delichon urbica*), however, was not seen although Gadow and Gardiner reported that it was plentiful during the latter's visit. Three pipits were recorded, one female of *Anthus t. trivialis* and one male of *A. cervinus* being collected. These pipits were seen around the playing fields and on the foreshore feeding grounds. Local informants reported that some years these birds may arrive in moderate numbers but they always depart southwards after a brief stay of a few hours to a day or so. Their destination is unknown.

Unfortunately, the Yellow Wagtail (*Motacilla flava*) was not observed during the visit but one was, curiously enough, during the homeward voyage from Colombo to Tilbury via Capetown. On 10 April 1957, when the ship was about latitude 1° 13″ S. and longitude 73° 37″ E., i.e. about 45 miles south of Addu Atoll and 320 miles north of the Chagos archipelago, a Yellow Wagtail came on board. It was in the fresh breeding plumage of a male with a bright grey-blue crown and a white superciliary stripe (probably either *flava* or *beema*). As this bird was observed in April it is probable that it was moving northwards ; it would be unlikely that during the South-west Monsoon it would be blown out to sea southwards from the Maldives. The presence of the bird in this area would appear to indicate then the possibility of occasional birds passing between the Maldives and the Chagos archipelagoes. Unfortunately we have a negligible knowledge of the birds of the Chagos islands, but this wagtail may provide a clue for future investigation into migration to that archipelago. The fact that the pipits continue southwards after their brief stay on North Malé Atoll lends support to this claim for the desirability for research into the avifauna of the Chagos archipelago.

CHECK-LIST OF THE BIRDS OF THE MALDIVE ARCHIPELAGO

Breeding Species	*Non-breeding Species*	*Species of Uncertain status*
R—Resident V—Visitor	N—Northern winter visitor S—Southern winter visitor	
PROCELLARIIDAE		
Procellaria lherminieri bailloni (R)	*Procellaria* sp. (S)	
	Oceanites oceanicus (S)	
PHAETHONTIIDAE		
Phaëthon lepturus lepturus (R)		
SULIDAE		*Sula leucogaster*
		Sula dactylatra
FREGATIDAE		
Fregata ariel iredalei (R)	*Fregata minor* (N)	
ARDEIDAE		
Ardea cinerea rectirostris (R)	*Ardeola ibis coromanda* (N)	*Egretta garzetta*
Butroides striatus albidulus (R)	*Ixobrychus cinnamomeus* (N)	
Butroides striatus didii (R)	*Dupetor f. flavicollis* (N)	
ANATIDAE		
	Anas crecca (N)	
	Aythya fuligula (N)	
FALCONIDAE		
	Circus macrourus (N)	
	Circus pygarus (N)	
	Circus aeruginosus (N)	
	Falco t. tinnunculus (N)	
RALLIDAE		
Amaurornis phoenicurus maldivus (R)		
Gallicrex cinerea (R)		
CHARADRIIDAE		
	Chettusia gregaria (N)	
	Squatarola squatarola (N)	
	Pluvialis dominca fulva (N)	
	Charadrius hiaticula tundrae (N)	
	Charadrius mongolus atrifrons (N)	
	Charadrius leschenaulti (N)	
SCOLOPACIDAE		
	Numenius phaeopus phaeopus (N)	
	Numenius arquata (N)	
	Limosa l. lapponica (N)	
	Tringa totanus eurhinus (N)	
	Tringa nebularia (N)	
	Tringa glareola (N)	
	Actitis hypoleucos (N)	
	Arenaria interpres (N)	
	Capella stenura (N)	*Capella gallinago*
	Erolia minuta (N)	
DROMADIDAE		
		Dromas ardeola

CHECK-LIST OF THE BIRDS OF THE MALDIVE ARCHIPELAGO—(*Contd.*)

Breeding Species R—Resident V—Visitor	*Non-breeding Species* N—Northern winter visitor S—Southern winter visitor	*Species of Uncertain status*
LARIDAE		
Sterna dougalli korustes (R)		*Gelochelidon n. nilotica*
Sterna sumatrana mathewsi (R)		
Sterna albifrons saundersi (R)		
Sterna anaethetus (V)		*Hydroprocne caspia*
Sterna fuscata (V)		
Thalasseus bergii velox (R)		
		Thalasseus bengalensis
Gygis alba (R)		*Anous stolidus pileatus*
		Anous tenuirostris
PSITTACIDAE		
		Psittacula calthropae
CUCULIDAE		
Eudynamys s. scolopacea (R)		
STRIGIDAE		
	Asio f. flammeus (N)	
APOPIDAE		
	Collocalia brevirostris (N)	
HIRUNDINIDAE		
	Hirundo rustica gutturalis (N)	
	Delichon urbica (N)	
MOTACILLIDAE		
	Anthus t. trivialis (N)	
	Anthus cervinus (N)	
	Motacilla flava (N)	
CORVIDAE		
Corvus splendens maledivicus (R)		

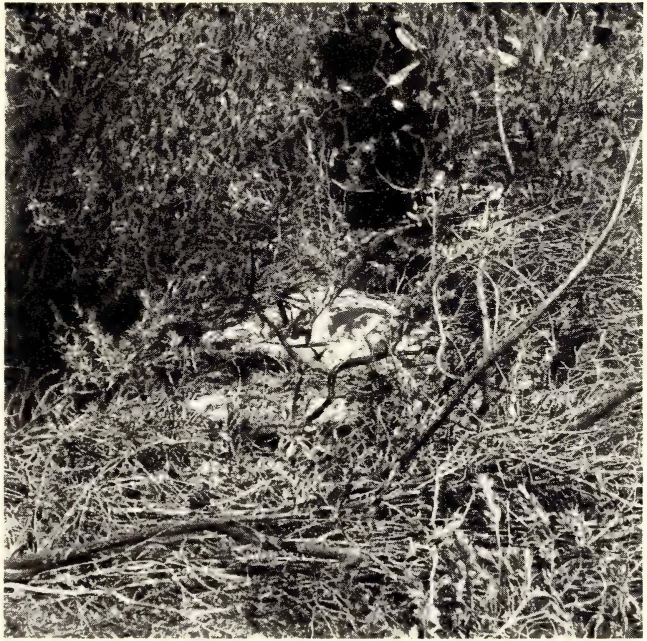
ANNOTATED LIST OF THE BIRDS OF THE MALDIVE ARCHIPELAGO

In this report, with few exceptions, the nomenclature and the sequence of families, genera, and species follow Phillips (1953). The Maldivian name for each species is given in parenthesis after the English name.

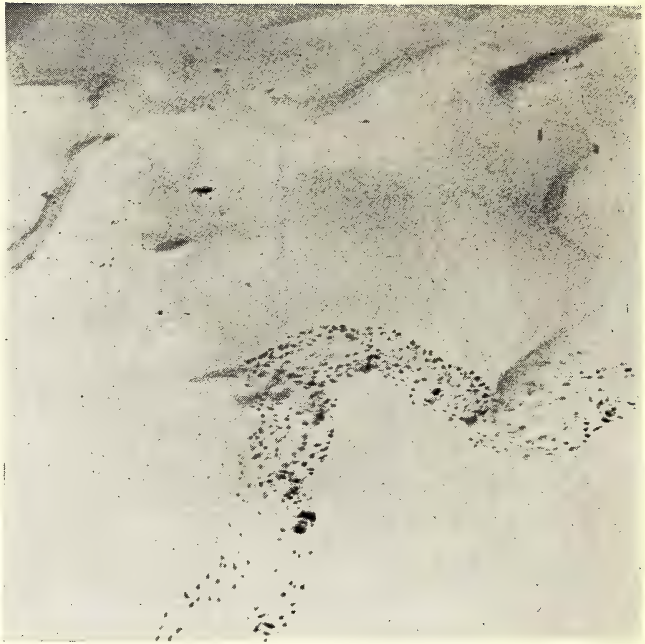
Procellaria lherminieri bailloni Bonaparte: Audubon's Shearwater. (Hoogula)

2 ad. ♂, 3 ad. ♀, 1 ? juv., North Malé Atoll, January 1957.

Gadow and Gardiner (1903) identified the Maldivian shearwaters as *persicus* Hume (from the coasts of Persia and India) but the present series

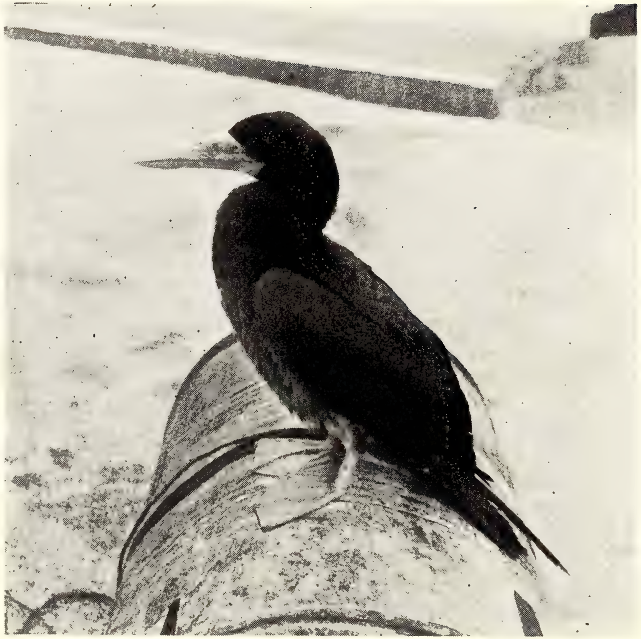


Nest-burrow of Audubon's Shearwater *Procellaria lherminieri bailloni*. North Malé Atoll

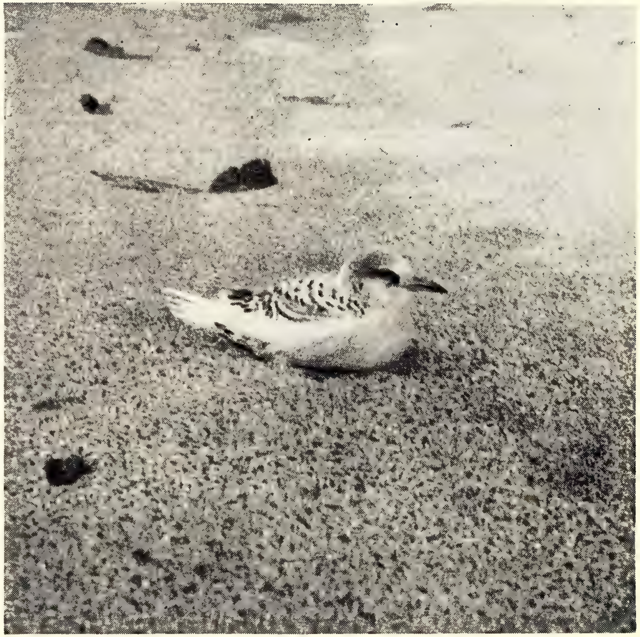


Tracks in sand, reputed to be made by Audubon's Shearwater *Procellaria lherminieri bailloni* when visiting nest-burrow at night. North Malé Atoll

Photos : W. W. A. Phillips



Brown Booby *Sula leucogaster*



Longtailed Tropic-bird *Phaëthon lepturus lepturus*, juvenile

Photos : W. W. A. Phillips

match specimens of the race of Audubon's Shearwater from the Seychelles both in size and colour. These birds are somewhat smaller, particularly in the length of the bill, than those of the more northerly occurring *persicus ;* also *bailloni* differs in the grey of the neck extending to the sides of the breast. The differences between these taxa are slight and seem to indicate a close relationship, so we propose that *persicus* Hume should be regarded no longer as a monotypic species but as a race of *P. lherminieri.*

Measurements (in millimetres) of *Procellaria lherminieri*

	Sex	Bill (Nostril to tip)	Wing
bailloni			
Maldives	2♂	21	195, 197
,,	3♀	21-22	185-198
Seychelles	1♂	21	181
,,	2♀	22, 23	189, 197
Reunion	1♂	21	worn
persicus			
Aden	1♂	25	210
Mekran coast	1?	25	199
Bombay (Colaba)	1♂	26	210
,, ,,	1?	25	199
Trivandrum*	1?	27	worn

We wish to thank the Bombay Natural History Society for their kindness in lending specimens of *persicus* taken near Bombay and Trivandrum from their collections.

It is curious that Maldivian shearwaters (or even the Indian race) have not yet been recorded in Ceylon. Occasional reports would be expected from off the coasts of individuals from this breeding colony on the Maldives or of injured or exhausted birds being washed ashore on the west coast during the South-west Monsoon.

All the present specimens were taken at the breeding burrow (the unsexed juvenile is unfledged). The breeding sites in the Maldive archipelago are reported to be widely scattered along the eastern sides of the islands in all the atolls ; burrows being particularly numerous on small, uninhabited, scrub-covered islets. The nest burrows are mostly within 20 feet of the shore and scraped out of the sand beneath roots of the scrub. The birds visit the burrows only at night, usually between midnight and 4 a.m.

In addition to the unfledged juvenile taken from a burrow on 26th January a single, slightly incubated, white egg measuring 49 × 35 mm. was taken from another burrow on 31st January. Gadow and Gardiner

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*Sálim Ali, 1953

(1903) reported that burrows contained eggs and young on 29th December. It would appear, therefore, that the breeding season is protracted, possibly throughout the cooler weather. Indeed, the islanders state that breeding continues throughout the whole year and we see no reason to doubt their statement as they take birds, young and old, and eggs for food.

Resident.

Procellaria sp. (Bodu-Hoogula)

The islanders report that large dark shearwaters which they name Bodu-Hoogula are often plentiful on the open seas around the atolls during the South-west Monsoon (April to October) but they do not come inside the reefs. As both the Greenbilled Shearwater, *P. pacificus*, and the Pinkfooted Shearwater, *P. carneipes*, occur regularly on the seas between the Maldives and Ceylon either, or both, could be the species observed.

Southern winter visitor.

Oceanites oceanicus (Kuhl) : Wilson's Petrel. (Kurangee)

New record. Large numbers of these petrels are reported to be present at times in the seas surrounding the atolls during the South-west Monsoon (April to October). Like the large shearwaters they remain outside the reefs where they are frequently caught by fishermen when they land on the boats. One was identified at sea, somewhat less than 100 miles east of the archipelago, on 28 November 1956.

Phaëthon lepturus lepturus Daudin : Longtailed Tropic-bird. (Dande fulu-doonie)

1♀, Tambrudu Island, North Malé Atoll, January 1957.

Gadow and Gardiner reported that this species bred on Mahlosmadulu Atoll where an adult, nestling, and egg were collected on 24th November. On 9 January 1957, a fully fledged juvenile, but still with some down, was brought in from Tuladu Island in South Mahlosmadulu Atoll, and a larger bird, too young to fly, was also brought from there on 15th January. Breeding in the Maldives appears, therefore, to take place during the cool weather from November to January and to be centred around South Mahlosmadulu Atoll. On Malé an occasional bird was heard calling and seen flying around the island and the neighbouring reefs.

Resident.

Sula leucogaster (Boddaert) : Brown Booby. (Mardoonie)

New record. A captive Brown Booby was photographed in February 1957 by W.W.A.P. The bird had been caught on a fishing line five months previously on Fadipollu Atoll. Others were seen near the

Cassanfaru Reef, North Malé Atoll. The species appears to be moderately plentiful in some areas in the archipelago but no information could be obtained of its breeding.

Status uncertain.

Sula dactylatra Lesson : Masked Booby. (Mardoonie)

New record. Two of these gannets were seen while our ship was stranded on the Cassanfaru Reef on the north-eastern aspect of North Malé Atoll. None was seen afterwards nor could any information be obtained regarding the status of the species.

Status uncertain.

? Fregata minor (Gmelin) : Frigate Bird. (Hora)

New record. Large, all-black frigate birds were seen over Malé on four occasions during December 1956, and January 1957. They appeared to be too large and dark for *F. ariel,* and with black abdomens were not *F. andrewsi,* so it is likely that they were *F. minor.*

Mr. Ibrahim Didi stated that frigate birds regularly appear over Malé during the cooler weather of the North-east Monsoon.

Northern winter visitor.

Fregata ariel iredalei Mathews : Lesser Frigate bird. (Hora)

2♀, Tuladu Island, Mahlosmadulu Atoll, January 1947.

Gadow and Gardiner recorded that this species bred on Mahlosmadulu Atoll during October and November. It is reported locally to breed only on the more northerly atolls.

Roosting frigate birds are captured in the palm trees and sold alive in the markets for food.

Resident.

Ardea cinerea rectirostris Gould : Eastern Common Heron. (Makana)

1♀, Malé, North Malé Atoll, December 1956.

This species is plentiful throughout the Maldives ; Gadow and Gardiner found it especially numerous on Mahlosmadulu Atoll. Herons are always to be seen on the reefs at low tide searching for eels. At high water they may be seen flying from reef to reef or, more usually, resting on breakwaters, trees, or palms. On Malé they are moderately tame and allow a close approach. Two partially fledged juveniles were brought in on 9th December, then on 4th January five empty nests were found in small bushy trees overlooking a lagoon, further on 15th January a down-covered nestling was also found. The breeding season appears to last from November, possibly October, to January or later. Although these herons are not captured for food, young birds are often taken from the nest and reared as pets.

Resident.

Butorides striatus didii : Phillips & Sims : Paler Maldivian Little Heron. (Rabonde)

2 adult ♂, 2 immature ♂, 3 adult ♀, Malé Island ; 1 adult ♂, Willinggillie Island ; 1 adult ♀, Hulule Island ; 1 immature ♂, Gardu Islet, North Malé Atoll, December 1956 and January 1957.

The race *didii* was separated on this series as the birds are markedly paler than birds of the more southerly occurring race, *albidulus*, also the crown is streaked (Phillips & Sims, 1958). The Little Heron is plentiful on the beaches and around the swamps of the central and northern atolls of the Maldives. The call is a short, sharp yelp.

Nests were found during December and January ; these are simple saucers, or platforms, of small sticks and twigs placed among the foliage on the horizontal branches of low bushy trees growing near the beach. Two well incubated eggs found on 2nd December were a rather pale green with a chalky appearance and measured 39×29 and 40×29 mm. respectively. Two quarter-grown nestlings were found on 16th January.

Resident.

Butorides striatus albidulus Bangs : Darker Maldivian Little Heron. (Rabonde or Rabulli).

This race is known only from the unique type collected on Suvadiva Atoll in the southern Maldives.

Resident.

Ardeola ibis coromanda (Boddaert) : Cattle Egret. (Irruwar Hudu)

2♂, Diffuri Island, North Malé Atoll, December 1956, January 1957.

New record. Cattle egrets are reported to be regular visitors arriving in small flocks of about 15 or so during October and November. They leave again during the following March and April after some of them have assumed the orange and buff breeding plumes. During their stay they usually remain in small flocks on the coral shores or reefs. The present specimens were snared by fishermen.

Northern winter visitor.

Egretta garzetta (Linnaeus) : Little Egret

Gadow and Gardiner recorded one bird on Hedufuri, South Mahlosmadulu Atoll and that two were seen in captivity on Huludu, Addu Atoll. This species was not seen by W.W.A.P. nor were there any local reports of it.

Status uncertain.

Ixobrychus cinnamomeus (Gmelin): Chestnut Bittern.

1♂, Toddu Islet, west of Malé Island, North Malé Atoll, December 1956.

New record. Regarded as a very occasional visitor during the North-east Monsoon.

Irregular northern winter visitor.

Dupetor flavicollis flavicollis (Latham): Black Bittern. (Karlu Rabonde)

2♂, Malé, North Malé Atoll, December 1956; Willinggillie Island, North Malé Atoll, January 1957.

New record. Small numbers arrive singly about December and stay during the remainder of the North-east Monsoon. They frequent scrub covered islets where they feed on the shores at low tide.

Northern winter visitor.

Anas crecca Linnaeus: Common Teal. (Ratu-rairu)

Gadow and Gardiner recorded that this species was reported from various parts of the Maldives. It was not encountered by W.W.A.P. but information was received of small flocks of up to ten being seen occasionally on the southern reef of Malé Island during the North-east Monsoon. It is considered to be more plentiful on islands with fresh or brackish water lagoons.

Northern winter visitor.

Aythya fuligula (Linnaeus): Tufted Duck. (Rairu)

New record. Two adult females that had been snared were brought in alive to W.W.A.P. and were examined by him. They came from a small flock that frequented the southern reef of Malé Island in November. Tufted duck are reported to visit the reefs occasionally during the North-east Monsoon.

Irregular northern winter visitor.

Circus macrourus (S. G. Gmelin): Pallid Harrier. (Bazzu)

This species was reported without comment by Gadow and Gardiner. It was not seen by W.W.A.P. but reports were gathered of it visiting the islands in varying numbers during the North-east Monsoon. It is possible that the islanders may confuse this species with *C. pygargus* although both may visit the islands.

? Northern winter visitor.

Circus pygargus (Linnaeus): Montague's Harrier. (Bazzu)

This species was reported without comment by Gadow and Gardiner. (See note on *C. macrourus*).

Northern winter visitor.

Circus aeruginosus (Linnaeus) : Marsh Harrier. (♂ Bazzu, ♀ Ahunda)

New record. A bird in adult male plumage was seen in the interior of Hulule Island, North Malé Atoll, on 26 December 1956. This was the only harrier observed during the visit although this species is reported to visit Malé regularly during the North-east Monsoon when it takes many domestic fowls.

Northern winter visitor.

Falco tinnunculus tinnunculus (Linnaeus) : European Kestrel. (Sirumuthi)

1♀, Hulule Island, North Malé Atoll, February 1957.

Gadow and Gardiner collected two specimens but gave no information. Several Kestrels were seen on Hulule Island, including an adult male on 17 January 1957. They were reported to visit the Maldives annually in moderate numbers during the North-east Monsoon. They appear to feed only on insects and *Calotes* lizards.

Northern winter visitor.

Amaurornis phoenicurus maldivus Phillips & Sims : Maldivian Waterhen. (Cumbilli)

3♂, 1♀, 1 juvenile, Hulule Island, December 1956 ; 1 juvenile ♀, Willinggillie Island, December 1956; 1♂, 1♀, Himmafuffi Island, January 1957; 1 juvenile ♂, Gardu Islet, North Malé Atoll, January 1957.

The race *maldivus* was separated mainly on the greater extent of white on the forehead and the more slaty coloured backs of the birds of this series in comparison with a series of *phoenicurus* Pennant (Phillips and Sims, 1958). The species is moderately plentiful on most of the larger islands throughout the Archipelago. It is an elusive skulking bird living amongst the undergrowth near the beach or around swampy areas ; frequently it is seen along the reefs at low tide searching for food. Many birds appear to have become entirely terrestrial and, except during the rainy weather, live away from freshwater and feed on the outskirts of clumps and thickets. The bird was reported to breed in the pandanus scrub and thickets during May or June to August and September. It can be very noisy at times.

Resident.

Gallicrex cinerea (Gmelin) : Watercock. (Coolee-Kukulu)

1♀, Malé, North Malé Atoll, January 1957.

New record. The Watercock was reported to be more common in the more northerly atolls of the Maldives ; it was said to breed during

June and July in the swamps around fresh, or brackish, water lagoons on some of the larger islands. Seldom seen on Malé Island where this specimen was collected.

Resident.

Chettusia gregaria (Pallas) : Sociable Plover. (Abulargee)

New record. Not observed by W.W.A.P. ; but small flocks were reported to visit the playing fields on Malé occasionally during the North-east Monsoon.

Irregular northern winter visitor.

Squatarola squatarola (Linnaeus) : Grey Plover. (Alaka)

1♀, Malé Island, North Malé Atoll, January 1957.

New record. A regular visitor seen usually singly or in pairs on the reefs of Malé and neighbouring islands during the North-east Monsoon.

Northern winter visitor.

Pluvialis dominica fulva (Gmelin) : Eastern Golden Plover. (Durrceen)

Gadow and Gardiner reported the presence of this species both in captivity and in the wild state. A single bird was brought in on 30 January 1957, having been snared about a week previously on the southern reef of Malé. During January, several were on this reef and it was reported that often small flocks visit the playing fields.

Northern winter visitor.

Charadrius hiaticula tundrae (P. R. Lowe) : Arctic Ringed Plover. (Findon)

1♂, Malé Island Atoll, December 1956.

New record. This specimen was the only one seen ; it was in company with a Lesser Sand Plover, *C. mongolus atrifrons*, on a patch of sand on the southern reef.

Irregular northern winter visitor.

Charadrius mongolus atrifrons Wagler : Lesser Sand Plover. (Findon)

1♀, Malé Island, North, Malé Atoll, December 1956.

New record. This specimen was the only one seen ; it was in company with an Arctic Ringed Plover, *C. hiaticula tundrae*, on a patch of sand on the southern reef.

Irregular northern winter visitor.

Charadrius leschenaultii Lesson: Large Sand Plover. (Bondun)

1♀, Dunidu Island, North Malé Atoll, December 1956.

New record. Several birds were seen on the southern reef of Malé Island. They were reported to visit Malé in small numbers during the North-east Monsoon.

Northern winter visitor.

Numenius phaeopus phaeopus (Linnaeus): Whimbrel.

2♂, 2♀, Malé Island, North Malé Atoll, December 1956 and January 1957.

Gadow and Gardiner regarded this species as common on Mahlosmadulu and Miladumadula atolls where birds were seen either singly or in small groups of three to four. They stated that it was a regular winter visitor to the Maldives from November to March. On North Malé Atoll it is one of the commonest winter visitors with flocks of up to 16 being seen by W.W.A.P. on the reef close to Malé Island.

Northern winter visitor.

Numenius arquata (Linnaeus): Curlew. (Bodu-Bulithumbi)

New record. One bird was definitely identified on the shore of Lankeumfurii Island, North Malé Atoll, on 6 February 1957. This was the only Curlew seen. Birds of this species were reported to be annual visitors staying in small numbers during the North-east Monsoon.

Northern winter visitor.

Limosa lapponica lapponica (Linnaeus): Bartailed Godwit. (Bulithumbi Elolly)

1♂, Malé, North Malé Atoll, December 1956.

New record. This specimen was snared on the southern reef; it was the only one seen. Birds of this species were reported to visit the islands annually in small numbers during the North-east Monsoon.

Northern winter visitor.

Tringa totanus eurhinus (Oberholser): Eastern Redshank. (Ratafy Elolly)

1♀, Malé, North Malé Atoll, December 1956.

New record. This specimen and another bird of the same species were seen on the southern reef. The species was reported to visit the islands annually in small numbers during the North-east Monsoon.

Northern winter visitor.

Tringa nebularia (Gunnerus): Greenshank. (Chunchun Elolly)

2♂, Malé Island, North Malé Atoll, December 1956 and January 1957.

New record. Several birds were always to be seen on the southern reef, a flock of nine being counted on one occasion. An annual visitor generally arriving in moderate numbers in early December.

Northern winter visitor.

Tringa glareola Linnaeus: Wood Sandpiper. (Findon Elolly)

1♂, Malé, North Malé Atoll, December 1956.

New record. Several birds were observed, always singly, on the southern reef of Malé Island during December and January. It was reported to be an annual visitor in small numbers during the North-east Monsoon.

Northern winter visitor.

Actitis hypoleucos (Linnaeus): Common Sandpiper. (Findon)

1♂, Hulule Island, North Malé Atoll, January 1957.

Gadow and Gardiner reported seeing birds of this species either singly or in small flocks of seldom more than six in number. Single birds are common on the shores and reefs throughout the North-east Monsoon; some occasionally visit the interior of the islands.

Northern winter visitor.

Arenaria interpres (Linnaeus): Turnstone. (Ratafy)

1♂, Malé Island, North Malé Atoll, December 1956.

New record. Plentiful, occurring in flocks up to 15 or more on the reefs throughout the North-east Monsoon. It is probably one of the commonest visitors to the Maldives.

Northern winter visitor.

Capella stenura (Bonaparte): Pintail Snipe. (Durrceen Elolly)

1♀ Hulule Island, North Malé Atoll, December 1956.

New record. This specimen was shot from a wisp of six in a small swamp on Hulule Island, others were seen on the reefs on Malé. It was reported to be an annual visitor staying in small numbers during the North-east Monsoon.

Northern winter visitor.

Capella gallinago (Linnaeus) : Common Snipe

Gadow and Gardiner reported that this species bred on Addu Atoll ; but it is possible that it was confused with *C. stenura* which was the only snipe seen by W.W.A.P. when on Malé Island[1].

Status uncertain.

Erolia minuta (Leisler) : Little Stint. (Kirru Bondun)

1♀, Malé Island, North Malé Atoll, December 1956.

New record. This specimen and, on another day, one other bird were seen on the southern reef at low tide. Little Stints pass through Malé annually in small numbers and may be a passage migrant.

Northern winter visitor (? Passage Migrant).

Dromas ardeola Paykull : Crab Plover. (Tayrawa ; juv., Moola Lumbo)

1♂, Malé, North Malé Atoll, December 1956.

Gadow and Gardiner reported that this species was seen only in mid-December 1899, on Miladumadulu Atoll, where it was particularly common around Furnadu. Parties of five to six in number, however, were frequently seen on the southern reef of Malé by W.W.A.P. in December and January. On three occasions a juvenile was seen in the company of adults, but breeding had not been observed by the islanders. From the size of the juveniles, it would seem that they would have hatched about July or August.

? Resident.

Gelochelidon nilotica nilotica (Gmelin) : Gullbilled Tern. (Kirru Dooni Amma)

1♀, Malé Island, North Malé Atoll, December 1956.

New record. This species was seen occasionally over the reefs in the North Malé Atoll but much less frequently than other species of terns. It is reported to breed, together with the other species, on the sandbanks and islets during March and April but this statement requires confirmation.

? Resident.

Hydroprocne caspia (Pallas) : Caspian Tern

New record. Three birds were seen separately over the Cassanfarra reef, North Malé Atoll, on 30 November 1956.

Status unknown.

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[1] The record of *breeding*, to whichever of the two species it may refer, is palpably erroneous. It must not be accepted without proof.—Eds.

Sterna dougalli korustes (Hume) : Eastern Roseate Tern. (Kirru Dooni)

2♂, 2♀, Fujarde Island, North Malé Atoll, January 1957.

New record. This tern was frequently seen flying over the reefs or settled on the sandbanks, usually in company with *S. sumatrana.* It was reported to breed on Fujarde Islet during March and April together with other species of terns.

Resident.

Sterna sumatrana mathewsi Stresemann : Blacknaped Tern. (Kirru Dooni)

3♂, 3♀ Fujarde Island, North Malé Atoll, January 1957.

Gadow and Gardiner regarded this species as being the most common tern occurring in the Maldives ; Gardiner saw large flocks from October to January. It was found by W.W.A.P. to be indeed most abundant ; it was reported to breed in very large numbers on Fujarde Islet and other sandy islets about March and April.

Like Audubon's Shearwater *P. lherminieri* it has, curiously, not been reported from Ceylon despite the fact that both breed in large numbers in the Maldives.

Resident.

Sterna anaethetus Scopoli : Bridled Tern. (Walla, or ?Walli)

New record. Large flocks were seen over the ocean between Ceylon and the Maldives. In the Maldives it was reported to breed amongst other terns on Fujarde and similar islets during March and April.

Breeding visitor.

Sterna fuscata Linnaeus : Sooty Tern. (Walla, or ?Walli)

New record. Large flocks were seen wheeling over the ocean between Ceylon and the Maldives. It was reported to visit the Maldives to breed during March and April.

Breeding visitor.

Sterna albifrons saundersi Hume : Little Tern. (Bondu, or Bondu-dooni)

2♂, 1♀, Fujarde Island, North Malé Atoll, January 1957.

New record. Flocks of about 25 birds were often seen over the reefs or on the sandbanks in North Malé Atoll. It was reported to breed, amongst *S. sumatrana* and other terns, on Fujarde Island during March and April.

Resident.

Thalasseus bergii velox (Cretzschmar): Large Crested Tern. (Gar-dooni)

4♂, Hulule, Weehammanarfurri and Dunidu islands, North Malé Atoll, December 1956 and January 1957.

Gadow and Gardiner reported that this species was abundant during the period October to January. It was found by W.W.A.P. to be moderately plentiful over the reefs and around the islands in the North Malé Atoll, usually in small numbers or even singly. It was reported to breed on Fujarde Island amongst other terns during March and April.

Resident.

Thalasseus bengalensis bengalensis (Lesson): Small Crested Tern. (Iammuti Gar-dooni)

3♂, Tulargiri and Wehammanarfurri islands, North Malé Atoll, December 1956 and January 1957.

New record. Small numbers of this tern were frequently seen on the reefs around small islands in the North Malé Atoll. It was reported to breed on sandbanks and islets during March and April but this statement requires confirmation.

Resident ?

Anous stolidus pileatus (Scopoli): Common Noddy. (Maranga)

2♂, 2♀, Tulargiri and Minueofinol islands and reefs, North Malé Atoll, December 1956 and January 1957.

New record. The Common Noddy is plentiful throughout the North Malé Atoll. The birds feed both within and outside the main reefs usually in association with other terns. It was reported to be present throughout the year but breeding had not been observed. Many birds are netted at night for sale as food.

? Resident.

Anous tenuirostris (Temminck) : Lesser Noddy

Gadow and Gardiner reported that this species bred on the South Mahlosmadulu Atoll in November ; but it was not observed by W.W.A.P.

? Breeding visitor.

Gygis alba (Sparrman): White Tern. (Cundu-Wallu-Dooni)

2 juv. ?, Addu Atoll, February 1957.

New record. The two juvenile specimens are too young for racial determination. It is possible that they belong to the same race as the Seychelles form, *monte* Mathews. They were brought in by the Hon. Mr. Ibrahim Ali Didi, the Prime Minister, who stated that the White

Tern breeds intermittently throughout the year on Addu Atoll but not elsewhere in the Maldives. The egg is laid on the branch of a tree or on a plantain (banana) leaf; the young survive because there are no predators on Addu Atoll. Even the House Crow *Corvus splendens* is absent from this southern atoll although it is present on most of the others.

Resident.

Psittacula calthropae (Blyth) : Emeraldcollared Parakeet

Gadow and Gardiner reported seeing a pair of birds, twice in January on Hulule Island, North Malé Atoll. The species was not seen by W.W.A.P. and parakeets are unknown to the islanders.

? Irregular visitor.

Eudynamys scolopacea scolopacea (Linnaeus): Koel. (♂, Karlukoel ; ♀, Dindin Koel)

2♂, 1 juvenile ♂, 3♀, Malé, North Malé Atoll, December 1956.

Gadow and Gardiner reported that koels were seen constantly during November and December on Mahlosmadulu, Miladumadulu, and Fadifoli atolls while during January one pair was seen on Hulule Island, North Malé Atoll. W.W.A.P. found koels to be plentiful on Malé Island and received reports that apart from Addu (where the House Crow is absent) koels occur throughout the majority of the atolls. More adult males were seen than adult females. Eggs are laid in the nests of the House Crow *Corvus splendens maledivicus.* A female, shot on the 11th December, dropped a fully formed egg.

Resident.

Asio flammeus flammeus (Pontoppidan) : Shorteared Owl. (Bukkamoonu)

Gadow and Gardiner recorded this species on Goifurfehendu Atoll in October and on Miladumadula Atoll in December. It was not observed by W.W.A.P. ; but it was reported to visit Malé and neighbouring islands occasionally during the North-east Monsoon, sometimes in moderate numbers.

Irregular northern winter visitor.

Collocalia brevirostris (Horsfield) : Edible-nest Swiftlet. (Forika)

New record. One swiftlet was seen on the morning of 19 December 1956 flying around a clump of mango trees close to the Guest House at Malé. It flew comparatively low when hawking for insects so it was identified with certainty. As there are no caves or tunnels in the Maldives suitable for breeding it was, presumably, a straggler.

? Straggler.

Hirundo rustica gutturalis Scopoli : Eastern Swallow. (Forika)

1♂, Malé Island, North Malé Atoll, December 1956.

New record. Although only one bird was collected several were seen during December; on two occasions two were seen flying together over the harbour breakwater. It was reported to visit the island annually in small numbers during the North-east Monsoon.

Northern winter visitor.

Delichon urbica (Linnaeus) : House Martin. (Forika)

Gadow and Gardiner reported that a number of martins arrived over Hulule Island at the end of January, also others were to be seen over Malé throughout February. However, martins were not observed by W.W.A.P. but it was reported to be an irregular visitor during the North-east Monsoon.

Irregular northern winter visitor.

Anthus trivialis trivialis (Linnaeus): Tree Pipit. (Fanfoudune)

1♀, Malé Island, North Malé Atoll, December 1956.

New record. For further notes see under *Anthus cervinus.* It is curious that this species has not yet been recorded from Ceylon for it occurs in southern India and now, on the evidence of this specimen, also in the Maldives.

? Passage migrant.

Anthus cervinus (Pallas) : Redthroated Pipit. (Fanfoudune)

1♂, Malé Island, North Malé Atoll, December 1956.

New record. This species does not normally migrate southwards through peninsular India, so it is possible that this bird was carried south-westerly across the Bay of Bengal by the North-east Monsoon. During December three pipits were seen of which two were collected, this specimen and another listed as *A.t.trivialis.* Pipits are well known on Malé where they visit the playing fields and grazing grounds. They were reported to arrive annually in small numbers during December but pass on after a few hours or, maybe, a day or so.

? Passage migrant.

Motacilla flava Linnaeus : Yellow Wagtail. (Fanfoudune)

New record. Not seen on Malé but in April one bird came on board a ship 45 miles south of Addu Atoll. Birds of this species were reported to arrive annually in Malé in small numbers during November and December. While on Malé they remain near the playing fields and the foreshore grazing grounds but soon pass on southwards after a few hours or perhaps even several days. Sometimes they are seen during March and April on their return flight.

Passage migrant.

Corvus splendens maledivicus Reichenow : House Crow. (Karlu)

2♂, 2♀, Malé Island, North Malé Atoll, December 1956.

Reichenow (1904 : 356) separated this race on colour differences between one specimen from Suvadiva Atoll, southern Maldives, and a series of House Crows from India, unfortunately without referring to birds taken in Ceylon. In colour the series now under consideration and two other specimens from the Maldives already in the British Museum (Natural History) differ but little from *protegatus* Madarasz of Ceylon and then only in the grey of the nape and neck being almost imperceptibly clearer in tone. The racial separation, however, can be upheld on size, the Maldivian bird, in series, being larger than birds from Ceylon.

Measurements (in millimetres) of *Corvus splendens*

	Ceylon		Maldives	
	Males	*Females*	*Males*	*Females*
No. of specimens	5	7	3	3
Wing ..	225-275	219-255	262-274	256-269
(mean)	(244.8)	(236.5)	(268.0)	(263.0)
Tail ..	147-156	128-149	158-172	158-168
(mean) ..	(152.5)	(138.1)	(165.0)	(162.6)
Culmen ..	46-49	42-45	50-54	47-49
(mean) ..	(47.4)	(42.6)	(52.0)	(47.0)

Three specimens, including one juvenile, from the Laccadives were also examined and were found to be nearest to the nominate form in colour and size. It seems that there may be a slight colour difference between birds of this population and those from peninsular India but, if there is, its significance cannot be assessed until longer series are available for study. Meanwhile, it is advisable to continue to list the population on the Laccadives as *C.s.splendens* Vieillot.

Gadow and Gardiner stated that this species breeds in the Maldives between May and September, that is, during the South-west Monsoon. A pair were building 30 feet up in a mango tree in the Guest House compound on 5 December 1956 and another pair were seen building on

7 January 1957 when all the crows appeared to be in fresh plumage. It is probable, therefore, that breeding continues throughout most of the year.

House Crows are abundant in Malé and, apart from Addu Atoll where they are absent, numerous throughout the Archipelago. They are fearless of man and as much a pest in Malé as, say, in Colombo. Their numbers seem to be kept in check largely by the Koel's cuckolding and by the Maldivian custom of shooting them on Friday afternoons.

Resident.

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* * *

Since the above was written, the following additional species have been observed by W.W.A.P. in Addu Atoll, the southernmost atoll of the Maldivian Archipelago. They should be included in the Check-list of the Birds of the Maldives.

Procellaria pacificus [? **chlororhynchus** (Lesson)]: Wedgetailed or Greenbilled Shearwater. (Bodu-Hoogula or Ma-Hoogula).

Plentiful in the Equatorial Channel, between Addu and Huvadu Atolls, in early July.

Procellaria carneipes Gould: Pinkfooted Shearwater. (Ma-Hoogula)

Small numbers observed in the Equatorial Channel in early July.

Ardeola grayii (Sykes): Pond Heron. (Hoodu-Rabulli)

Plentiful in swamps and on reefs throughout Addu Atoll.

Anas querquedula Linnaeus : Garganey. (Rairu).

One, in captivity on Hittadu Island, was caught with three others from a small flock that visited the island during the North-east Monsoon season.

Erolia temminckii (Leisler) : Temminck's Stint. (Kirru-Bondun)

One remained for several days, towards the end of May, in a swamp on Gan Island.

Erolia testacea (Pallas) : Curlew-Sandpiper. (Findon)

Plentiful in flocks up to 45/50, on Gan Island, during May and June.

W.W.A.P.

PART IV—AMPHIBIANS AND REPTILES

BY

W. W. A. PHILLIPS

Miss Grandison and Mr. Battersby of the British Museum (Natural History) have very kindly supplied the following list of identifications of the Amphibian and Reptile collections. Due acknowledgement is made of, and thanks tendered for, their assistance. In the following list, the field-notes by the author are placed in brackets.

ANNOTATED LIST

TOADS

BUFONIDAE

Bufo melanostictus Schneider

Nos. 8, 9, half-grown: Malé.

Previously recorded from Malé Atoll and Addu Atoll (Laidlaw). (Plentiful in Malé; mainly nocturnal; noisy croaking on wet nights. Maldivian name=Bouk.)

LIZARDS

GEKKONIDAE

Hemidactylus frenatus (Schlegel)

Nos. 3, 22, 12, ♂♂; -?, 7, 21, ♀♀: Malé.

Abundant and widely distributed. Laidlaw reports it from fourteen localities. (Plentiful in buildings; chiefly nocturnal. Maldivian name=Hornu or Honnu.)

Hemidactylus brookii Gray

Nos. 4, -?, ♂♂; 23, 24, ♀♀; 13, half-grown: Malé.

Recorded by Laidlaw from Hululé, Malé Atoll as *H. gleadovii* (=*H. brookii*). (Plentiful; lives chiefly in trees, amongst the foliage. Maldivian name, as above.)

AGAMIDAE

Calotes versicolor (Daudin)

Nos. 15, 14, 16, 18, ♂♂; 6, 2, 5, half-grown ♀♀; 17, ♀: Malé.

Nos. 27, ♂; 26, -?, ♀; Hululaé Island, N. Malé Atoll.

Very abundant in Maldives. Laidlaw reports it from these and other localities. (Abundant on all islands visited. Maldivian name= Boundu.)

SCINCIDAE

Riopa albopunctata Gray

Nos. 19, half-grown; 99 (4 specimens), adult and half-grown; -?, half-grown; 28, half-grown; 33, adult; -? (2), adult and young; 34, half-grown; -?, adult; 29, adult: Malé.

Nos. -?, half-grown; -?, half-grown: Girawa Island, N. Malé Atoll.

Common species; Laidlaw records it as *Lygosoma albopunctatum*, from many localities. (Plentiful on most islands; lives amongst dead leaves. Maldivian name=Gahaheta.)

SNAKES

TYPHLOPIDAE

Typhlops braminus (Daudin)

No. -?, adult: Girawa Island, N. Malé Atoll.

A wide-spread species. Laidlaw reports it from Manadu in Miladumadulu Atoll. (One only, seen; dug up in loose soil; said to be unknown in Malé. Maldivian name=Nanuguttee.)

COLUBRIDAE

Lycodon aulicus capucinus Boie

No. 32, ♀ : Hululé, N. Malé Atoll.

Nos. 53, -?, 25, -?, 41, -?, 37, 30, 31, 38, ♀♀; 40, 10, -?, 39, 11, ♂♂ : Malé, N. Malé Atoll.

Although the anal is usually divided this plate is single in two of the specimens of this collection; the anomalous condition has previously been reported. Two specimens recorded by Laidlaw from Hululé as variety A, which means without spots on the labials. This character is not constant and such condition may also be found in variety D. [Plentiful in Malé; chiefly nocturnal; lives in holes in trees and walls; feeds on lizards (*Calotes versicolor*). Said to be the only snake known in Malé. Maldivian name=Nanuguttee.]

HYDROPHIIDAE

Pelamis platurus (Linne)

Nos. 2, 3, 4, Adults: Himmafurri Island, N. Malé Atoll.

These three specimens represent two colour varieties, two of the black and brown forms and one as variety E with an intervening yellow stripe.

Laidlaw reports one specimen as *Hydrus platurus,* var. E. (Taken in the sea off a reef some 20 miles NE. of Malé; reported to be plentiful outside the main reefs but rarely seen inside; none seen at Malé. Maldivian name=Feng-harufar.)

TURTLES

Eretmochelys imbricata (Linne)

2 young: Malé. Caught 1 December 1956.

Laidlaw records this species as being very common off the Maldives and Laccadives. (Plentiful around Malé; Maldivian name=Carhambu.)

None of the above species was previously represented in the B.M. from the Maldives.

Laidlaw recorded the following species in addition to those listed above:

SNAKE

Aspidura trachyprocta Cope, from Malé.

TORTOISE

Nicoira trijuga thermalis (Lesson) from Hulué, Malé Atoll.

(Plentiful in swamps on Hululé island close to Malé; reported) to have been liberated there. (Maldivian name=Kandhu Kahambu).

TURTLES

Chelone mydas (Linne)

A recent report on the Maldives (Deraniyagala 1956) increases the herpetofauna with:

Dermochelys coriacea (Linne): A nest on an island near Hululé.
Caretta caretta gigas Deraniyagala: Two nests on Gulifalu Island.

LIZARDS

Mabuya carinata (Schneider): A single specimen from Malé.

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Preliminary Studies on the Seasonal Variation in Starch Content of Bamboos in Kerala State and its Relation to Beetle Borer Infestation

BY

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(*With two graphs*)

The starch content in felled bamboos has long been recognized to be essentially correlated with their susceptibility to attack by beetle borers. Beeson (1941) observed that there is fluctuation in the concentration of starch in living bamboos in the different seasons. Gardner (1945) noted that at Dehra Dun starch content in the living culm varied with the season. It was highest in May and June, decreased with the commencement of the monsoon in July to the end of August, remained constant in September, rapidly decreased to the minimum level in November-December, and once again rose to reach the maximum in May. It was also seen that the degree of attack on felled bamboo by beetle borers, which need starch for their development, is correlated with the variation of starch content in the culm. In view of this observation the months July to January were considered safe, under Dehra Dun conditions, for felling bamboos, ensuring least attack by beetle borers. Jones (1948) conducted some trials under climatic conditions prevailing in Travancore (now Kerala), and found the months June and July as the safe period to fell bamboos. Plank and Hageman (1951) noted a positive correlation existing between starch content in different varieties of bamboos and their susceptibility to powder-post beetle infestation.

The present paper embodies the results of further studies made in continuation of those already reported (Jones, 1948). The main purpose of these studies has been to ascertain the most favourable period for felling bamboos ensuring least borer infestation under conditions prevailing in Kerala.

MATERIALS AND METHODS

Culms used in the present investigations were selected from well-established clumps of *Bambusa arundinacea* Willd., growing wild in the reserve forest at Kallar (near Trivandrum). Ten pieces, each five feet long, cut out from the basal region, were collected at random every month from culms of about two years' growth. Three rings, each two inches long, were cut out from three of these pieces chosen at random and analysed for starch content. A.O.A.C. methods of analysis were used. Of the ten pieces collected each month, five were split lengthwise each into two equal halves, and five kept unsplit. The split and unsplit pieces were all kept exposed to natural beetle infestation. After one year under storage the pieces were examined for borer attack, the degree of infestation being assessed by noting the number of holes on the pieces made by the borer beetles.

The species of beetles found attacking bamboos are *Dinoderus minutus* Wlk., and *Minthea rugicollis* Wlk.

Results

Starch content of bamboos in different seasons:

Table I gives the concentration of starch in monthly samples of bamboo collected during the period April 1948 to March 1949. Figure 1 represents the same. It will be seen that the concentration is highest in February, decreases gradually till the end of May, and shows a sudden drop from June, reaching the lowest level in July and August. A good increase is registered in September and a slight drop in October and November. From then onwards the starch concentration rises gradually to the peak point once again.

TABLE I

Monthly starch content of bamboo during the period April '48 to Mar. '49

Month	Starch content % of samples			Average starch content	Standard deviation
	I	II	III		
1	2	3	4	5	6
January ..	15.15	16.42	15.28	15.75	0.4864
February ..	19.70	19.20	18.10	19.02	0.6749
March ..	14.80	16.45	16.16	15.80	0.7891
April ..	12.52	13.17	12.07	12.59	0.3464
May ..	14.37	12.79	10.16	12.14	0.7365
June ..	11.96	19.56	14.52	15.36	3.1544
July ..	9.04	8.70	9.51	9.08	0.4133
August ..	8.84	10.97	10.56	10.12	0.9586
September ..	14.68	14.20	15.78	14.89	0.5815
October ..	11.49	12.55	14.84	12.95	1.4354
November ..	14.96	12.70	13.05	13.57	0.9932
December ..	15.28	20.79	13.60	16.56	3.0530

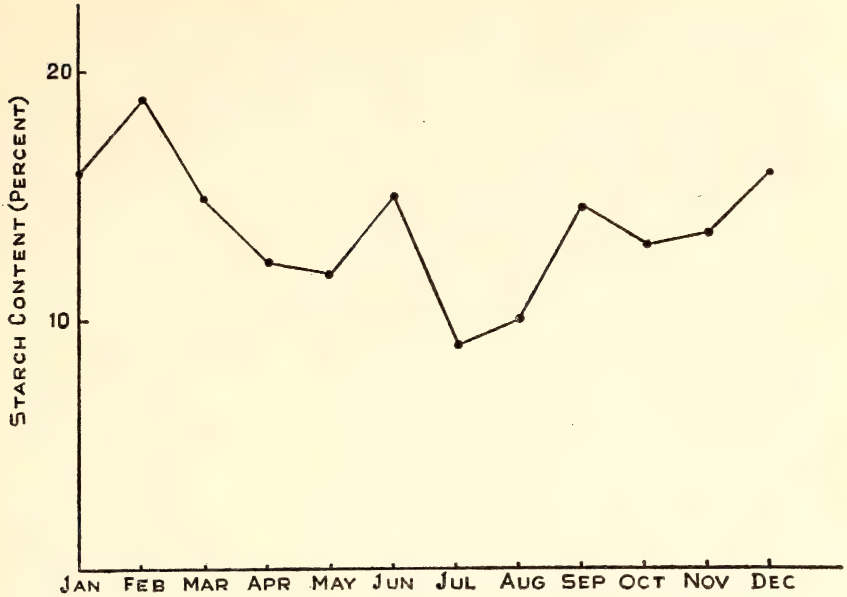

Fig. 1. Monthly variation in starch content in bamboo in Kallar (Kerala State)

Analysis of variance is given in Table II. It is seen that 'F' is very highly significant, the 1% value being equal to 3.09, indicating that the variation in starch content from month to month is highly significant. Now, critical difference $=\sqrt{\frac{2 \times 3{\cdot}534}{3}} \times t_0$ where t_0 is the value of 't' from 't' tables corresponding to d.f. 24 and significant level 0.05, or $\sqrt{\frac{2 \times 3{\cdot}534}{3}} \times 2{\cdot}064 = 3{\cdot}168$. According to this the months of the year can be graded into four groups based on starch content, as shown in Table III. It is seen that starch content is low in July and August, moderate in April to June and September to November, high in December to January and March and very high in February.

TABLE II

Analysis of variance of data in Table I

Source of variation	Sum of squares	Degrees of freedom	Variance	F
Between months	256.7714	11	23.343	6.605
Remainder	84.8165	24	3.534	
Total	341.5879	35		

TABLE III

Grouping of months according to starch content in bamboo

Degree of starch content	Months	Average starch content in the months included in the group%
Low ..	July, August	9.60
Moderate ..	April, May, June, Sept., Oct., and November	13.63
High ..	Dec., Jan., and March	16.04
Very high ..	February	19.02

Starch content and its relation to borer attack:

Data on the intensity of borer attack on bamboos felled during the months grouped above are given in Table IV. Statistical analysis shows that the values of chi. squares of independence for unsplit and split bamboos are 18.5 and 10.43 respectively.

TABLE IV

Relation between starch content and borer attack

Month group	Degree of starch content	No. of pieces showing different ranges of borer holes				
		I Less than 10	II 11 to 50	III 51 to 150	IV Above 150	Total
July, Aug.	Low (a)	10				10
	(b)	4	6			10
April to June & Sept. to Nov.	Moderate (a)	24	4	1	1	30
	(b)	8	15	1	6	30
Dec., Jan., Mar.	High (a)	7	2		6	15
	(b)	6	2		7	15
February	Very high (a)	2			3	5
	(b)	2			3	5
Total	(a)	43	6	1	10	60
	(b)	20	23	1	16	60

(a) denotes unsplit and (b) split pieces.

In the case of unsplit bamboos the value of chi. square 18.15 has a probability of being exceeded only less than 0.05 and therefore is very significant. In the case of split bamboos, however, the probability of exceeding the calculated chi. square value lies between 0.30 and 0.20 and hence the assumption of the existence of an association does not seem quite justified. This is unexpected, and an explanation for it does not appear possible with the present data.

The correlation between the concentration of starch in bamboos and the highest intensity of borer attack has, however, been found to be very significant. The results of the observations are given in Table V and represented in Fig. 2. It will be seen that for split as well as unsplit bamboos the percentage of pieces showing the maximum intensity of borer attack is highest in the lot showing 'very

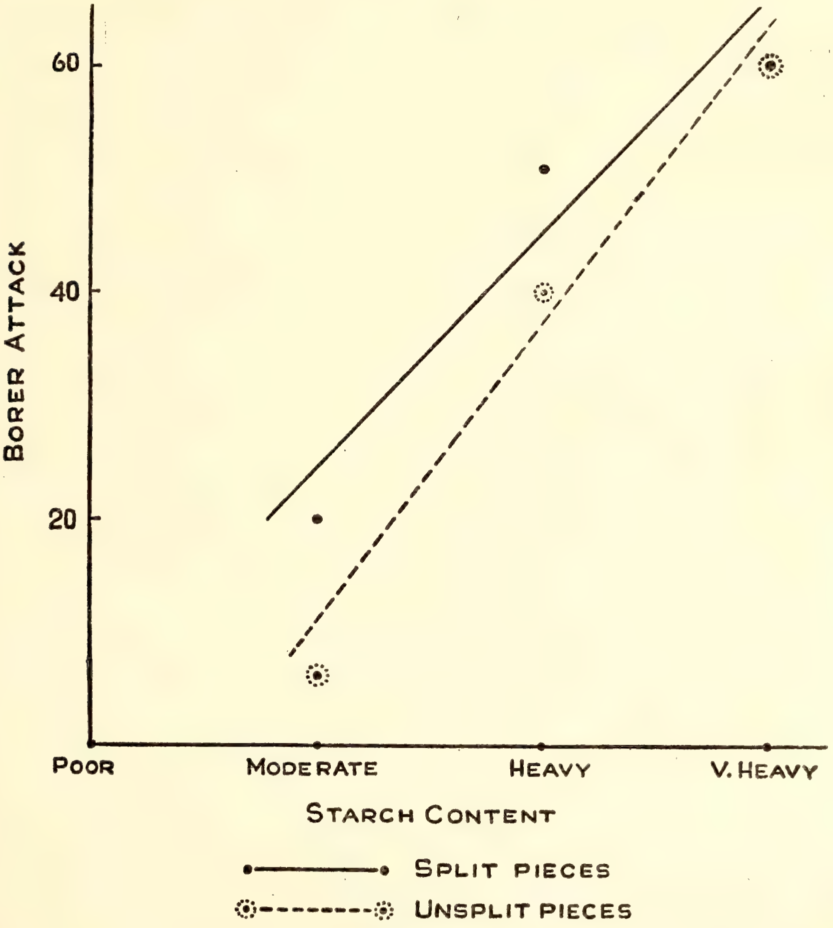

Fig. 2. Association between starch content and borer attack

high' starch concentration, this being followed in the descending order by lots with 'heavy' and 'moderate' concentrations.

TABLE V

Starch content in relation to highest intensity of borer attack
(Percentage of bamboo pieces showing more than 150 holes)

Group	Starch content				Total
	Poor	Moderate	Heavy	Very heavy	
Split pieces ..	0	20.00	46.67	60.00	16.67
Unsplit pieces ..	0	3.33	40.00	60.00	26.67

DISCUSSION

Depletion of starch in bamboos has been attributed to rains and the growth of new culms (Gardner, 1945). The present findings lend support to this observation. It is seen that with the pre-monsoon showers in March to May there is appreciable depletion of starch, and following heavy monsoon showers in June-July there is a sharp drop. This period is also characterised by vigorous growth of new culms. The cessation of rains and the subsequent lowering of growth rate of bamboos result in increased accumulation of starch as reserve food. It is also seen that the 'starch high' and 'starch low' months in Dehra Dun and Kerala are different. In Kerala, starch concentration is highest in February and least in July-August. The present investigations confirm the observation recorded by previous workers that a positive correlation exists between starch content and borer attack. Based on this information it may be inferred that the best time for felling bamboos in Kerala would be during the months July and August.

SUMMARY

Concentration of starch in bamboo felled in the different months of the year in Kerala shows significant monthly variations. Based on the concentration of starch, the months of the year fall under four groups, namely (1) July and August showing low concentration (9.60% average); (2) April to June and September to November, showing moderate concentration (13.63%); (3) December, January, and March showing high concentration (16.04%); and (4) February, showing very high concentration (19.02).

Starch content and intensity of borer attack on felled bamboos are positively correlated. The best time to fell bamboo in Kerala, ensuring minimum attack by beetle borers, is during the months July and August.

ACKNOWLEDGEMENTS

The author is thankful to Mr. S. Janardana Iyer, of the Statistical Department, Central Research Institute, Trivandrum, for the analysis of data, and to Dr. P. V. Nair, Professor of Applied Chemistry, for the chemical examination of the samples. He wishes to express his appreciation of the assistance rendered by Sri. S. P. Christudas in the course of these investigations. He is grateful to the Director of Research, University of Travancore, for kindly providing the necessary facilities for the work.

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New Species and Forms of Lepidoptera from Afghanistan and Iraq[1]

BY

E. P. WILTSHIRE, F.R.E.S.

(*With a plate and three text-figures*)

The exploration of the lepidoptera of the Middle East continues. Afghanistan is comparatively unknown, and since the Second World War has been visited by three expeditions[2], of which that of J. Klapperich in 1952-3 produced the material for the following descriptions from that country. I am much indebted to Father Froitzheim of Essen for permission to study part of this material, which he has so meticulously preserved and prepared. An account of the expedition and some descriptions of new species in other groups have already appeared[2], and there is reason to hope that the next few years will see further additions to our knowledge of the Afghan fauna.

As regards Iraq, besides my own collections of 1935-8, 1942-4, and 1952-7, the north of this country has also been visited by the well-known Rhopalocera specialist, Dr. L. Higgins, in May-June 1957. Though concentrating on butterflies he did not ignore the moths and among his captures of the latter are several new records for Iraq listed below, and one new species described below.

During summer 1957 in England I was able to investigate certain problematical Iraqian species about which only provisional opinions could be inserted in my recent book (August 1957). The present article includes a more final verdict on these, and shows that in the case of the *Archanara* from SE. Iraq I erred on the side of caution in not immediately describing it as a new species in the book.

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[1] This is the XIVth article in this taxonomic series on Middle East Lepidoptera. The previous one (XIIIth) appeared in *The Entomologist* **89**, No. 1121; it dealt with material from Jordan. Too large to be considered as in the series is 'The Lepidoptera of Iraq' (2nd Edition), Nicholas Kaye, August 1957, London, to which reference is made in the present article as 'Wiltshire (August 1957)'.

[2] The following papers deal in part with these three expeditions, one of which was Danish and two German:

Amsel, H. G. (1957): Die Deutsche Afghanistan-Expedition 1956 der Landessamlung für Naturkunde in Karlsruhe. (*Beitr. z. naturk. Forsch. i. Sudwestdeutsch.* **16**. H. 1. pp. 1-28.)

Boursin, C. (1957): Description de huit nouvelles *Caradrina* O.d' Afghanistan de 1' expedition Klapperich et de deux *Oedibrya* Hps. (*Bull. Mens. Soc. Linn. de Lyon* **26**. No. 6. 158-163.)

Clench, Harry K. & Shoumatoff, N. (1956): The 3rd Danish Expedition to Central Asia. Zoological Results. 21. Lepidoptera Rhopalocera (Insecta) from Afghanistan. (*Vidensk. Medd. fra Dansk. Naturh. Forem* **118**.)

Klapperich, J. (1954): Auf Forschungsreisen in Afghanistan. (*Ent. Blatt.* pp. 107-118.)

I am particularly grateful for the assistance given me by Mr. W. H. T. Tams during these studies, and also must acknowledge my debt to Messrs. C. Boursin and C. L. Collenette.

Family LASIOCAMPIDAE

Dendrolimus klapperichi sp. n. (Plate, Figs. 9, 10)

This dull brown, faintly marked, fair-sized moth recalls in pattern some *Metanastria* but in genitalia comes nearer to *Dendrolimus*. The course of the intra-neural series of black marks on the forewing, parallel to the outer margin, easily distinguishes it from the known species of those two genera, for in them the corresponding marks form a more angular, broken, submarginal line.

♂ antenna, orange-brown, bipectinated.

♀ antenna, pale brown with shorter pectinations.

Head, palps, thorax, and abdomen, dark greyish brown.

Forewing, dark greyish brown, paler marginad, darkest basad and costad. Markings, very faint and consisting only of three triple, faint, postmedian lines parallel to the outer margin, of which not all are always discernible, and a clearer submarginal series of intra-neural black marks, arranged roughly parallel to the outer margin. Fringes, concolorous.

Hindwing, dark greyish brown; fringes, concolorous.

Underside, both wings, monotonous greyish brown.

Span: 45-50 mm.

Holotype, ♂, Afghanistan, Nuristan, Bashgul Valley, 26-4-53, 1,100 m., leg. Klapperich, in coll. Klapperich.

Allotype, ♀, same locality and captor, 3-5-53, in coll. Klapperich.

Paratypes, 3 ♂, same locality and captor, 4-5-53, in coll. Klapperich, Wiltshire, and British Museum.

Family LYMANTRIIDAE

Euproctis froitzheimi sp. n. (Plate, Fig. 6)

Palps, black. Feet, whitish grey.

Male antenna, grey, copiously bipectinated.

Head and thorax, yellow. Abdomen, with pale yellow hairs.

Forewing, plain yellow; fringes, concolorous.

Hindwing, whitish, fringes pale yellow.

Underside, forewing with costa black near base, ground colour paler yellow than upper side; hindwing pale yellow.

Span: 32 mm.

Holotype, ♂, E. Afghanistan, Paghman Mts., 28-8-53, 3,000 m., leg. J. Klapperich, in coll. Klapperich.

I designate as paratypes a series of similar examples from north India in the British Museum, at present unnamed.

Family NOTODONTIDAE

Damata dicyma sp. n. (Plate, Fig. 5)

This fair-sized, beautiful, and very distinctive greyish moth is smaller than its relatives.

Antenna black, bipectinated.

Head, palps, and thorax, dark fuscous, except for the pale grey, dark-edged tegulae. Abdomen, dirty grey.

Forewing olive-grey, finely powdered with black and white, and crossed by three wavy black markings. The first of these is the median band, filled in with black at the costa, narrower on crossing the cell, and olive-grey-centred towards the hind-margin. Orbicular stigma, represented by two faint white spots, reniform, by a not very large but clear white oval spot, about 1 mm. long and at right angles to the hind-margin. The post-median fascia is represented by a double wavy black line, the proximal strand being smoky black, the distal strand marked with white on some of the nervures and followed on the costa by a black shade. Submarginal line, wavy, obsolete, pale grey. Fringes, dark grey, chequered with whitish.

Hindwing, brownish-grey, with traces of a pale post-median line, clearest at the anal angle where it is edged proximally with a wavy fuscous border and distally with a broader fuscous border. Fringes, as on forewing.

Underside, forewing brownish grey, with upper-side markings represented on costa only, and only the post-median markings being traceable there; three black shades and a paler spot between the second and third of these comprise these costal marks. Fringes, as on upper-side. Hindwing, whitish grey with curved brown ante-median and post-median fasciae, between them a distinct brown cell-spot. The pale outer edge of the post-median fascia is followed by brownish apical and anal shades. Fringes and nervures, marked as upper-side.

Span: 60 mm.

Holotype, ♀, Afghanistan, Nuristan, Bashgul Valley, 1,100 m., 9-4-53, leg. Klapperich, in coll. Klapperich.

Harpyia pulcherrima Brandt **nuristana** subsp. n. (Plate, Fig. 7)

This race, spanning 31 mm., is larger and has the dark markings deeper and more extensive than the typical Zagros form from Iraq and SW. Persia.

Holotype and paratype, Afghanistan, Nuristan, Bashgul Valley, 1,100 m., 9-4-53 and 14-4-53, leg. Klapperich, in coll. Klapperich and mea.

Harpyia lanigera Butl. **terminata** forma n. (Plate, Fig. 8)

There is not enough material to decide whether this form represents an aberration or a subspecies. The fringe chequer-spots are united in it to form a continuous grey post-terminal line along part of the forewing termen. Otherwise it is very similar to the British Museum's series of *lanigera* from Kashmir and Japan, and to the type of that species from Japan.

Holotype, 1 ex. Afghanistan, Faizabad, Kokscha Valley. 1,450 m., 7-8-53, leg. Klapperich, in coll. Klapperich.

Family PHALAENIDAE (AGROTIDAE, NOCTUIDAE)

New forms and species in this family taken by Herr J. Klapperich in Afghanistan are described either in articles by Monsieur Boursin if *Trifinae* (the first of these articles is mentioned in footnote 2), or if *Quadrifinae* will appear in later articles by myself, together with new *Geometridae*. The following *Trifinae* are from Iraq.

Lithophasia cyaxares sp. n. (Plate, Fig. 3)

A preliminary brief description of this appeared in Wiltshire (August 1957), No. 297*a*.

Antenna, filiform in both sexes, with white and sepia scales near base. Palps, wood brown and darker brown, mixed. Collar and head, similar, tufty. Thorax, very tufty, with white, pale brown, and sepia scales mixed. Feet, coloured like thorax.

Forewing, varying between pale wood brown and deep sepia, marked with snow-white, and recalling in coloration *Cucullia verbasci* L., but smaller and with general aspect suggesting a *Cleophana*. Costa and cell, pale wood brown dusted with grey and whitish; these form a pale area edged by the median nervure, outlined darker brown; stigmata, absent. Seven of the nervures reaching the outer margin are indicated in brown outline from the cell to the margin and are more or less distinctly white-edged on both sides marginal; the fringes are brown, chequered finely with pure white at the termination of the nervures. Dark sepia streaks separate the nervures in the submarginal area. Between nervures 1 and 2 and parallel to the former runs a characteristic, arrow-like streak from base to tornus, starting as a deep sepia basal streak and prolonged into a club-shaped, snow-white centred loop, terminating below and short of the end of the cell, and followed by a pure white arrow-head whose point links up with the white intra-neural marginal lunule between nervures 1 and 2.

Forewing under-side, less distinctly marked, but the nervures near the termen are as in the upperside; so is the fringe.

Hindwing, pale dirty brown, darker in the ♀, with nervures infuscated. Termen, a fine brown line, pale-edged. Fringes, whitish. Underside, as upperside.

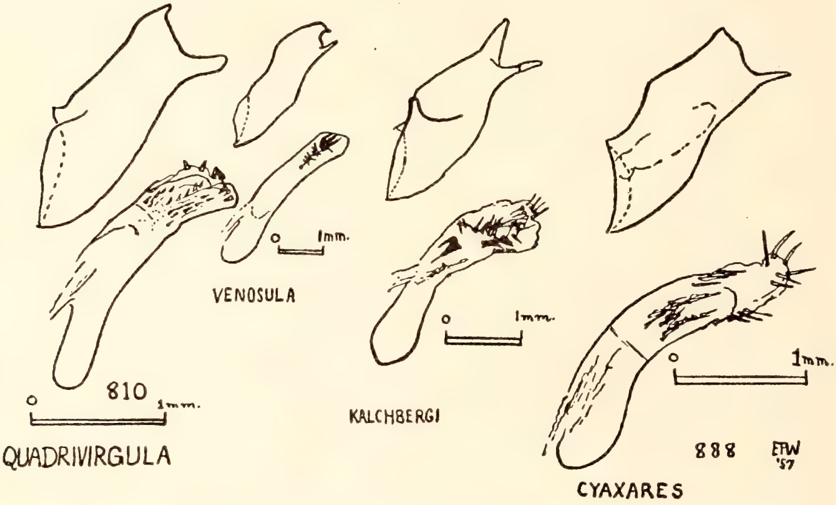


Fig. 1. Right valve and aedeagus of four *Lithophasia* and *Bryomima* species.

The male genitalia, shewn in text fig. 1 (Prep. 888), shew the affinity of this distinctively marked species to two other *Lithophasia* species, namely *quadrivirgula* Mab. and its form *jordana* Stgr. and *Lithophasia* (=*Hypomecia*) *venosula* Stgr.; the hitherto unpublished genitalia of *Bryomima kalchbergi* (first described, wrongly, as an *Antitype*) are also shewn in the same figure for comparison, having been traced from the photo of a preparation of the type of that species made by Monsieur Charles Boursin, to whom I am much indebted; evidently the genus *Bryomima* is not distant from *Lithophasia*.

Holotype and allotype, ♂ and ♀ respectively, Iraq, Kurdistan, province Erbil, Haj Omran, 1,525-1,830 m., 2 to 13-6-56, leg. E. P. Wiltshire, in coll. m.

Agrochola egorovi B.-H. **laciniatae** subsp. n. (Plate, Fig. 2)

Though distinct in aspect from typical *egorovi* this moth is here introduced as a subspecies of it on account of the similarity of the male genitalia. I am obliged to M. Charles Boursin for a photo of the genitalia of the type of *egorovi* from Daghistan. It may possibly be distinct. The early stages are described, and the foodplant provides the new form's name.

From typical *egorovi* as described and illustrated in Seitz III Suppt. the new form differs in its less-marked forewing. In particular, the conspicuous brown angulated central shade of *egorovi* is absent, and the black markings also not in evidence. The general colouring is dull orange-yellow with faint orange-brown lines. Only the wavy post-median and submarginal lines and termen are completely defined. The lower lobe of the reniform stigma is slightly paler; the outlines of the stigmata are very faint. Underside, paler yellow, unmarked. Hindwing, whitish. Span, 30 mm.

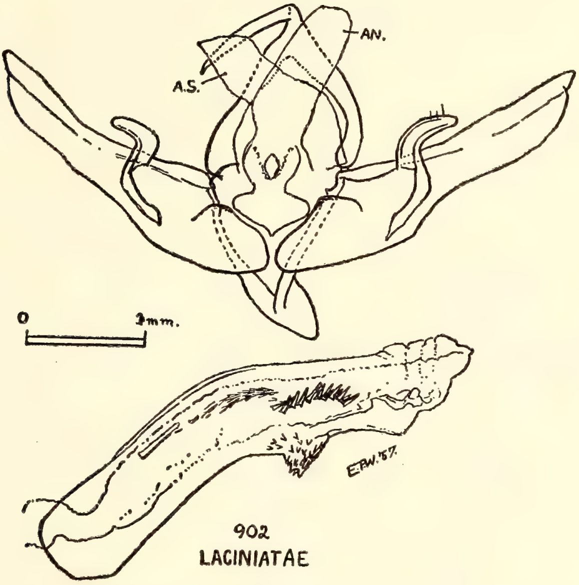


Fig. 2. Male genitalia, open ventral view, with aedeagus separated, of *Agrochola egorovi laciniatae* ssp. n. (AS = aedeagus sheath; AN = anus)

The male genitalia (shewn in text fig. 2) differ from those of *egorovi* only in the greater extension of the costal tip of the valves and the more evenly tapering form of the uncus, and perhaps also the blunter-formed harpe.

Holotype: 1 ♂, Iraq, Kurdistan, province Erbil, Haj Omran (nr. Rayat), *c.* 1,830 m., bred from larva found in flowers of *Eremostachys laciniata,* a giant labiate with wool-clad, white inflorescence. Hatched 18-10-56; in coll. m. This species was referred to under no. 317*a* without definite determination in Wiltshire (August 1957).

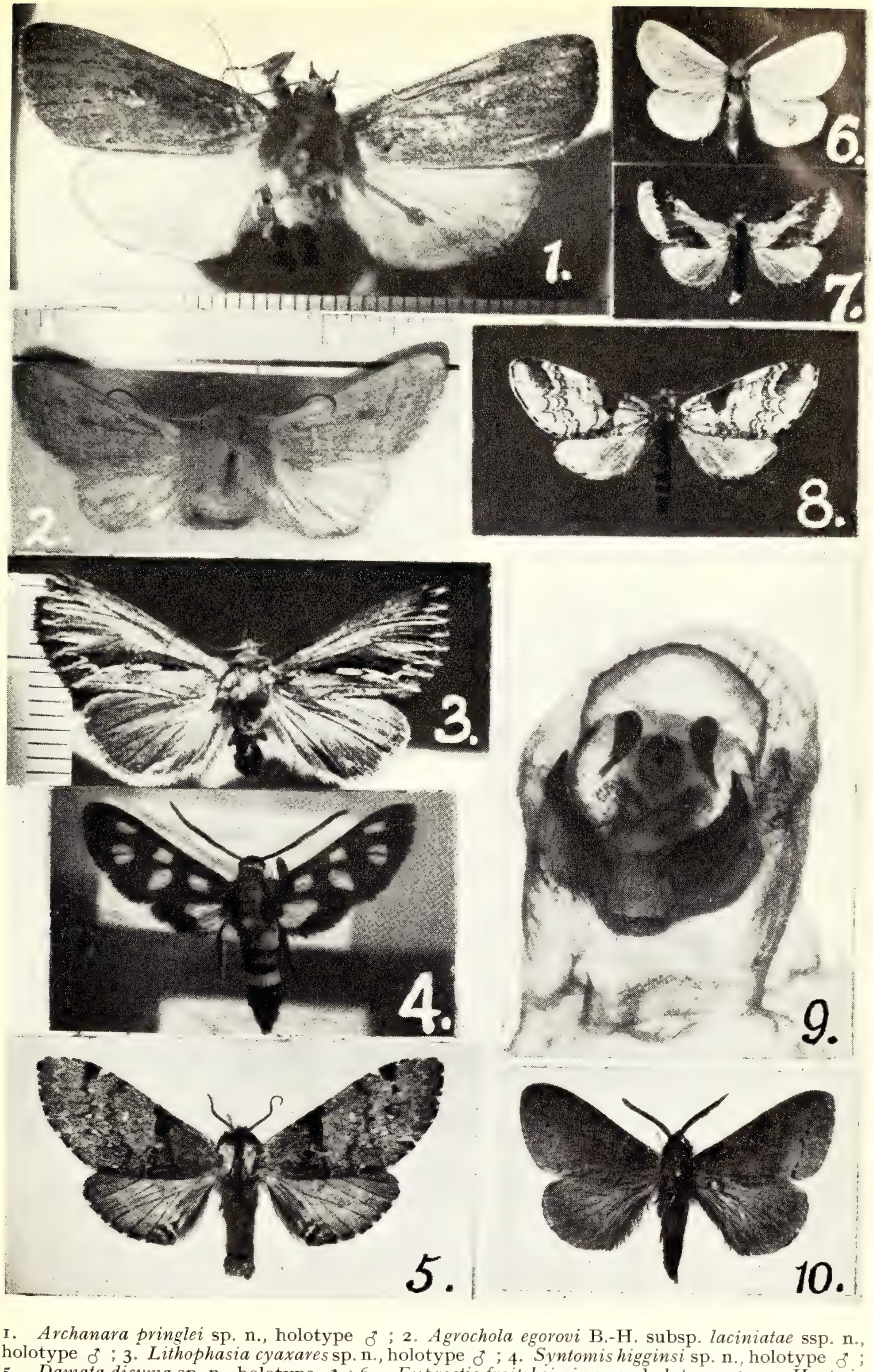
The larva when found in June was about 1½″ long and of a whitish green colour with a pale yellow head. The sublateral stripe was whitish, the wrinkles at the somital joints were yellowish, and there were no other markings. The feet were pale, the spiracles were inconspicuous. A week later the colour became dull red-brown, darker dorsally, putty-coloured sublaterally. The head was now buff or putty-coloured. It ate no more on assuming this colour but remained torpid; after a few days it spun a cocoon on June 14. Since the cocoon was against glass, it was possible to observe the larva's development. It became smaller, more whitish and discoloured during the summer, and indeed had a diseased appearance before finally turning into a healthy pupa on September 18. The moth emerged a month later.

This phenology is typical of all Middle East and Near East *Agrochola* species which I have bred myself or of which the early stages have been published [cf. Pinker, R., 1956: Beschreibung der Raupen einiger pontischer und mediterraner Heteroceren. *Zeits. der Wiener Ent. Ges.* 41 J. (67 Bd.) No. 10. pp. 265-270].

Archanara pringlei sp. n. (Plate, Fig. 1)

In Wiltshire (August 1957) this moth appeared as No. 382*a* and was attributed, with a query, to *insoluta* Warren-Seitz. I have now seen Warren's three types (all ♀♀) from Central Asia, and they are evidently a distinct species without the need for dissecting the same sex of both forms. *A. insoluta* has shorter forewings with a more arched costa and usually better defined fasciae. The Iraqi form is larger, richer red-chestnut in colour, plainer, lacking the pale costal suffusion and the black terminal intraneural dots of *insoluta.* I therefore introduce it here as a new species named after its captor, Dr. G. Pringle, the malariologist and dipterist, who has worked many years in Iraq and taken some interest in its lepidoptera.

Tongue, developed. Palp, pale grey-brown in front and above, but dark brown on sides. Head, brown mixed with pale grey scales. Thorax and abdomen, chestnut brown. Forewing, warm chestnut brown, without any fasciae, the post-median being represented by a series of very short black streaks on the nervures, some of which terminate in a small white spot. The costal and medial nervures and v. 1 are powdered with dark grey and white scales as far as these



1. *Archanara pringlei* sp. n., holotype ♂ ; 2. *Agrochola egorovi* B.-H. subsp. *laciniatae* ssp. n., holotype ♂ ; 3. *Lithophasia cyaxares* sp. n., holotype ♂ ; 4. *Syntomis higginsi* sp. n., holotype ♂ ; 5. *Damata dicyma* sp. n., holotype ♂ ; 6. *Euproctis froitzheimi* sp. n., holotype ♂ ; 7. *Harpyia pulcherrima* Brandt, subsp. *nuristana* ssp. n., holotype ♂ ; 8. *Harpyia lanigera* Butler, forma *terminata* f. n., holotype ♀ ; 9. *Dendrolimus klapperichi* sp. n., paratype ♂, genitalia ; 10. *Dendrolimus klapperichi* sp. n., paratype ♂. (Figures 5, 6, 7, and 10 natural size, others enlarged).

post-median streaks. At the lower corner of the cell there is a conspicuous single white point. Nervures, slightly and finely powdered with dark grey and white scales crossing the marginal area. Termen and fringes, concolorous.

Hindwing, whitish, the nervures lightly infuscated and a wide marginal brownish shade from the apex but not reaching the anal angle; in this shade are faint traces of a wavy pale submarginal line. Nervures 2 and 3 are each dotted with brown just after leaving the cell.

Underside, both wings, pale dirty whitish with metallic, bronzy sheen, infuscated on the nervures, with a faint powdering of grey scales near the outer margin and elsewhere.

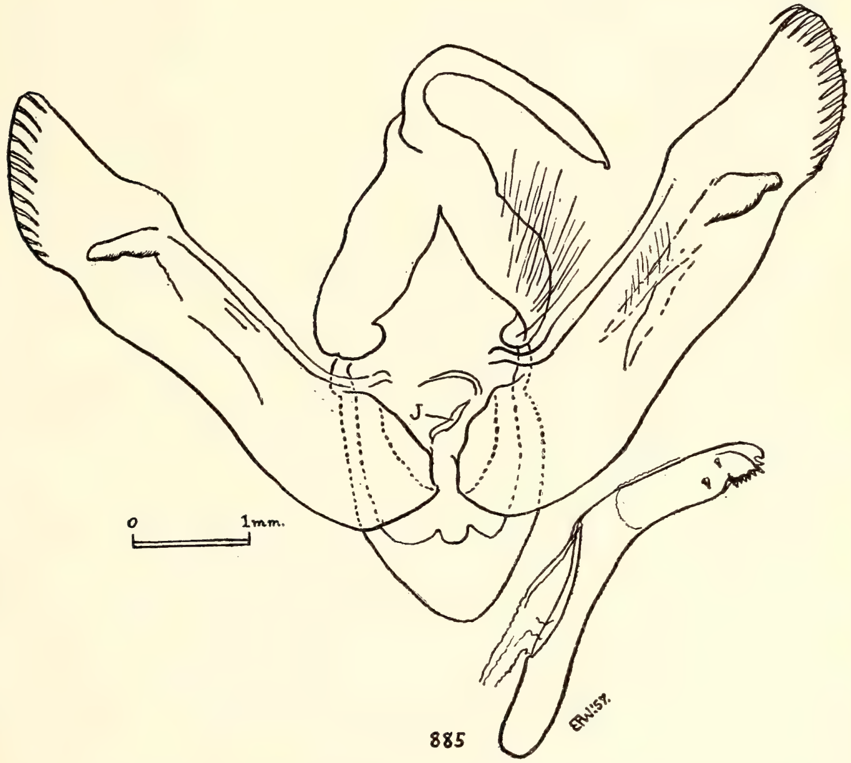


Fig. 3. Male genitalia, open ventral view, with aedeagus separated, of *Archanara pringlei* sp. n. (J = juxta).

The male genitalia (see text fig. 3) (Prep. 885) show affinity both to *Nonagria typhae* Thunb. and to *Archanara geminipuncta* Haw., and the new species may therefore be placed after the former and before the latter.

Span: 42 mm.

Holotype, 1 ♂, Iraq, Amarah marshes, near sea-level, 15-5-56, leg. G. Pringle, in coll. m.

Family SYNTOMIDAE

Syntomis higginsi sp. n. (Plate, Fig. 4)

Antenna, black.

Head, black, with yellow or white collar. Thorax, yellow or white. Abdomen, black with yellow or white rings, that on somite 8 being entire and conspicuous, those on somites 4-7 being dorsal but not ventral, and variable in extent.

Forewing, black with yellow or white spots, placed as in *sintenisi* Wlngrn. or *aurivala* Schaw. but large and more angular in form. Hindwing, yellow or white with a black marginal border which widens towards the apex.

Span: 21 mm.

The following key will help to distinguish these three species:

A 1. Thorax and head, black.

A 2. Thorax yellow or white; head with yellow or white collar.

A 1. Forewing and hindwing black with small yellow spots; hindwing yellow spot, very small, sometimes absent ... *sintenisi*

A 2. (i) Forewing and hindwing as in A 1. Antenna with yellow tip. ... *aurivala*

(ii) Forewing with larger, angular yellow or white spots; hindwing, yellow or white, with black border. Antenna, black ... *higginsi*

Holotype and paratype: Iraq, Kurdistan, Salah-ud-din, 1,037 m., 3 to 10-6-57, leg. L. Higgins (in British Museum).

Paratype: same data, in coll. m.

The three species named above are similar in size and obviously close relatives; and all occur within about 300 miles of each other. They are however never found, as far as I know, together. *S. aurivala* and *higginsi* seem to be very local forms, while *sintenisi* extends from east Turkey (whence there is a series in the British Museum from Mardin) to west China. Until biological observations give contrary indication, they should be considered distinct species.

Both Herr J. Klapperich and Dr. L. Higgins have added a number of species hitherto not recorded from Afghanistan and Iraq respectively. A list of such from Afghanistan will appear separately later, but the additions to Iraq's fauna list, known too late for inclusion in Wiltshire (August 1957), are as follows:

Family PHALAENIDAE (AGROTIDAE, NOCTUIDAE)

Triphaena subsequa Schiff.
Hadena syriaca Osth.
Hadena pumila Staudinger
Hadena pfeifferi Draudt
Calophasia acuta Freyer
Omphalophana durnalayana Osth.
Leptosia sefidi Brandt
Hylophila bicolorana Fuesl.
Phytometra daubei Boisd.

Family SYNTOMIDAE (AMATAIDAE)

Syntomis minuta B.-H.
Syntomis aequipuncta maraschi Dan.

Family GEOMETRIDRAE

Pseudopanthera syriacaria Guen.
Chiasma clathrata L.

Family PYRALIDAE

Tretopteryx pertusalis Hubn.
Noctuelia superba Freyer

All the above were taken in the scrub-oak zone of the mountains of northern Iraq, except *P. daubei* which was taken to light in the central plain, on oasis ground near Bagdad, by Dr. Dhia Ahmad.

A few Notes on the Preparation and Publication of Gamble's Flora of the Presidency of Madras

BY

D. DANIEL SUNDARARAJ
Agricultural College and Research Institute, Coimbatore

(*With a plate*)

Every botanist in India knows Gamble's FLORA OF MADRAS, but few of them know the details of how such a monumental work came to be written. The following pages will attempt a detailed account of the preparation of the Flora.

The FLORA OF MADRAS was one of the last provincial floras to be published on the completion of the FLORA OF BRITISH INDIA by Sir J. D. Hooker and his associates. A very brief account of the story behind the FLORA OF MADRAS is given by Sir Arthur W. Hill, the Director of the Royal Botanic Gardens, Kew, in the preface to the 11th part of the FLORA OF MADRAS. Further details may be gathered from the introductory notes to the various parts and from the critical notes published in the Kew Bulletin as each part made its appearance. A few extracts from old correspondence may be of interest to Indian botanists.

Col. D. Prain, the Director of the Royal Botanic Gardens, Kew, by a letter dated the 19 July 1909, proposed to the Secretary of State for India in Council that the preparation of the Flora of Madras be undertaken, and that the work be entrusted to Theodore Cooke on the same terms as those under which this author had published his FLORA OF THE PRESIDENCY OF BOMBAY, Cooke had published the last part of his Flora of Bombay in 1908, and the Director of the Royal Botanical Gardens, Kew, thought it would be of advantage if his experience was made use of in the preparation of the Madras Flora.

The following are the terms under which Cooke published his Flora of Bombay:

1. The work should be issued in parts of about 200 pages each.

2. The profits of the first edition should go to the author, but the Government should reserve to itself the copyright of the book.

3. An honorarium of £50 to be paid to the author on the publication of each part.

J. S. Gamble

C. E. C. Fischer

4. 500 copies to be purchased by the Government at a discount of 12½% of the published price, which should not exceed 8*d*. per sheet of 16 pages.

The matter was then referred to the Commissioner of Revenue Settlement, Survey, Land Records, and Agriculture, Madras, who in turn referred it to M. E. Couchman, the Director of Agriculture, Madras. At the time Dr. C. A. Barber was the Government Botanist, and was appropriately consulted on the matter. Dr. Barber's opinion is of interest. He agreed that the need for a Flora of the State of Madras was a pressing one; in the Madras Government Herbarium there were more than 30,000 sheets which could scarcely be identified in the absence of a local Flora. He pointed out, however, that in south India there were large tracts outside the Presidency proper which needed intensive exploration; under the circumstances it would be difficult to give correct details about the distribution of plants until such tracts had been explored and the existing materials in the Government Herbarium had been worked out. His final suggestion was that exploration be intensified, the identification of materials be taken up at once, and only after the completion of these tasks would it be possible to write up a complete Flora.

The Government of Madras was not agreeable to the delay this would involve and, on 5 January 1910, an order was issued by the Government stating that the preparation of the Flora was an urgent need and that Dr. T. Cooke be requested to take up the matter at once. A letter of the same date written to the Government of India by the Government of Madras states: 'His Excellency the Governor in Council recommends that the preparation of the Flora of Madras Presidency should be entrusted to Dr. Theodore Cooke . . . Even allowing that the materials for such a Flora are not ideally perfect or absolutely complete, its publication would, in the opinion of the Government, do far more to advance botanical study in the Presidency than the production of any preliminary materials intended to lead up to a local Flora later. Such publications will not give the same stimulus to workers in the field of Botany or be as readily available for their use as a formal Flora, summing up the results at present attained. If such a Flora is found twenty years hence to need revision, it will still have served as a standard for research in the interval, while even if the undertaking of a formal Flora were postponed, it is not to be expected that finality will ever be attained.'

Just as these proposals were taking shape, towards the close of the year 1909, Dr. Theodore Cooke was struck down by an illness of a grave character. Dr. Prain reports on Dr. Cooke's interest in the work in the following terms: 'This illness, while severely affecting his physical powers, has left his intellectual capacity unimpaired and his interest in the task of preparing a Flora of the Presidency on behalf of the Government of Madras has remained as keen as ever . . .' However, all these plans had to be given up on receipt of a letter of regret from Mrs. Cooke, dated the 26 March 1910, in which she explained that her husband had become incapacitated for the task. Dr. Cooke died on 5 November 1910.

At the suggestion of Mr. Lodge, the Conservator of Forests, Southern Circle, the Government of Madras urged the Government of India in August 1910 to request Mr. J. S. Gamble, C.I.E., to undertake the work. Gamble had retired from the Forest Service in 1899 and, at the time he was asked to undertake the publication of the Flora of Madras, was engaged, in collaboration with Sir George King, in the collection of materials for a Flora of the Malay Peninsula. For this reason, he 'was compelled to defer the inception of the task' of preparing the Flora of Madras. In 1913, after a delay of about two and a half years, Mr. Gamble suggested to the Government of India and the Government of Madras that Mr. T. S. Dunn, formerly the Superintendent of the Botanical and Forestry Department, Hongkong, be permitted to collaborate with him in the preparation of the book; this suggestion was accepted by the Government on the recommendation of Col. Prain.

In order to expedite the work, it was arranged that the herbarium sheets from the Madras Herbarium should be packed and despatched to Kew as soon as possible. Specimens belonging to the families Ranunculaceae to those of *Smithia* in the Papilionaceae left the port of Madras by sea in November 1913. Meanwhile the first World War broke out, and the rest of the specimens could not be dispatched until the end of the war in 1919. In spite of this, however, Parts II and III of the Flora from the Papilionaceae to Caprifoliaceae were prepared and published from materials kept in other herbaria, mostly those of the British Isles. The obstruction caused by the war actually forced Gamble to look into some collections of Madras plants that otherwise might have passed unnoticed, as for example those of Roxburgh, Elliot, Wight, Cleghorn, and others in the herbaria of the Royal Botanic Gardens, Edinburgh, of the British Museum (Natural History), the Dubois collections, etc.

The first 182 pages of the Flora of Madras were prepared in draft form by T. S. Dunn; he scrutinised the specimens of the Madras Herbarium from *Clematis* in the Ranunculaceae to *Biophytum* in the Geraniaceae and checked their identities; but in 1915 Dunn 'was then most unfortunately obliged to relinquish his share in the work' (Gamble, in Intro. to Part I, FL. MADR.). However, before he went out, Dunn contributed a critical paper entitled 'Notes on the Flora of Madras' in the *Kew Bulletin* 1916.

Gamble began his work from the Rutaceae and went steadily checking all the sheets in the Kew Herbarium, and other sheets sent to him from time to time. His critical examination of such sheets is a model for any botanist; the floral parts of the many sheets were dissected, then carefully drawn, and the detailed drawings attached to the original sheet. On this count alone, it may be said that Gamble's work in the Kew Herbarium is about the best and most critical; certainly no such detailed examination was made in the preparation of other provincial Indian floras. Gamble continued his labours until 1925 when he died on the 16th October; at the time of his death he had finished the examination and writing of the Euphorbiaceae, and a few further genera in the Ulmaceae.

Sir Arthur W. Hill, at the time the Director of the Royal Botanic Gardens, Kew, recommended that Mr. C. E. C. Fischer be requested to continue the work of Gamble. Fischer was a retired officer from the Indian Forest Service, who had had long experience of south Indian botany and was undoubtedly the most competent man at the time. Fischer took on the work and continued the critical examination of specimens from *Celtis* onwards, that is to say from Part VIII to the end of Part XI. The first part of Fischer's work was published in 1928, the last in February 1936; Fischer, following the example of Gamble, published three sets of critical notes on the Flora. The work of Fischer, unfortunately, is not of the high standard of Gamble; his examination of the herbarium sheets was done somewhat hurriedly, or so it appears from examination of the same —one does not find the careful dissections and drawings seen on Gamble's sheets.

Thus, the publication of the FLORA OF MADRAS took in all 22 years and engaged the attention of three distinguished botanists, Dunn, Gamble, and Fischer. It has remained the best of the provincial Floras of India, and probably on this account the edition soon became exhausted. With the revival of the Botanical Survey of India, and the great interest created in students for botanical exploration, the need for copies of the book has become critical. Happily the Botanical Survey of India has decided to bring out a reprint of the same, so as to supply the immediate need. It would have been more appropriate to revise this and other provincial Floras; but the work of revision will be a long one and may take a number of years. In the meanwhile students of Botany will be able to use Gamble's Flora of Madras in its original form, while they gather more detailed information on which the new revision will have to be based. Meanwhile the floras of smaller areas of Madras are being prepared by various botanists. All such local floras will be of great help in the final revision of the Flora of the whole State.

ACKNOWLEDGEMENTS

The author is greatly indebted to Rev. Fr. H. Santapau for having gone through the original manuscript and for bringing it out in the present form. He also renders his thanks to Dr. Rama Rao, Principal, and Sri Somasundaram, Curator, of the Southern Forest Ranger's College, Coimbatore, for the photographs of Gamble and Fischer kindly made available for publication.

Botanical Exploration in East Nepal

BY

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(*With a map*)

The kingdom of Nepal occupies about one-third of the Himalayas and extends from 80° 15′ to 88° 10′ E. and 26° 20′ to 30° 10′ N. The total area is 54,000 sq. miles, the length being about 525 miles and the breadth varying from 90 to 140 miles. The entire kingdom approximately corresponds to the central Himalayas.

The history of botanical exploration in Nepal begins early in the 19th century when Hamilton (1802-03) and Wallich (1820), both famous botanists, spent a year or two in Nepal collecting plants amongst the forested hills near Kathmandu and its vicinity. They induced pilgrims to Gossain Kund to bring back plant specimens. B. H. Hodgson went to Kathmandu in 1822 as Assistant Resident, and later as Resident. For the 21 years that he stayed in the Valley he laboured on the natural history of Nepal. In later years many have devoted their time and energies to the cause of the natural history of the country, but our knowledge of it has remained quite meagre. In recent years mountaineering expeditions are being accompanied by scientists and, when the results of all these expeditions are published, the natural history of Nepal will be greatly enriched.

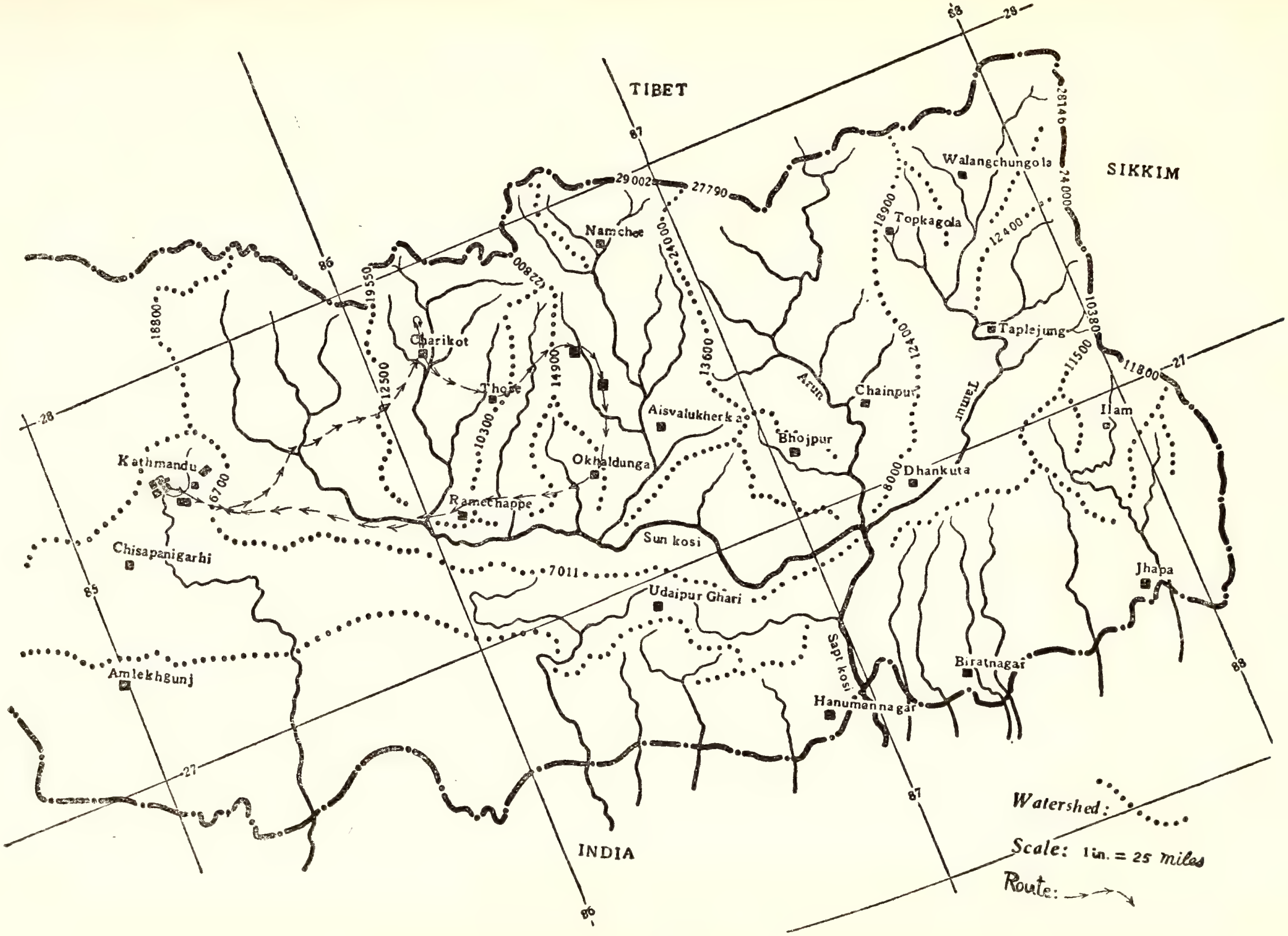
I have been interested in the study of the vegetation of east Nepal (85° 20′-88° 10′ E. and 26° 30′-28° N.) since 1948; five visits to the country were made during the pre-monsoon months. The first post-monsoon collection was made during the months of August, September, and the early half of October 1956. In the following pages an account of this excursion is given. The route that was followed is given in the accompanying sketch map.

KATHMANDU TO CHARIKOT

With a complement of six porters I left Kathmandu on the 25th August. Kathmandu Valley is saucer-shaped, with a diameter of 10-15 miles. The valley is thickly populated and heavily cultivated. The adjoining small cup-like valley of Bhadgaon is followed by a still smaller valley in which Banepa is situated. As one descends from Banepa (1,680 m.) to the Jhikku Khola, the vegetation all around is rather sparse. The soil is very loose and of a grey colour. At most of the places the bare slopes have started eroding and gully formation has started. The Jhikku khola valley is about 3 miles in length east to west and about 1½ miles north to south. Rice is the principal crop. Along the slopes the vegetation is composed of *Pinus roxburghii,* and *Rhus parviflora* with *Woodfordia fruticosa* ; in some places *Trema politoria* is occasional. In the ravines *Shorea robusta* is localised. Along the banks of Sun Kosi, Indrawati, and other principal streams, where the altitude is as low as 765 m., *Acacia* spp., *Zizyphus* spp., and *Jatropha curcas* form the principal species. At certain places *Ipomea quamoclit* with beautiful crimson flowers grew over the shrubs. *En route,* where the path ascends to about 1,375 m., *Swertia angustifolia* is in profusion. Under shade and in moist places *Begonia* spp. was in great abundance and in flower. At a little lower altitude *Rhus parviflora* formed pure formations and the ground was covered by prostrate *Desmodium triflorum* and *Crotolaria albida; Polygala triphylla* was occasionally seen.

The vegetation around Chaubas, which is at 1,985 m., is strikingly different. Chaubas is exposed on all sides except the north and is windswept. The flat grassy meadows are full of *Herminium gramineum, Spiranthus australis, Micromeria biflora, Desmodium triflorum,* and *Hypericum elodeoides.* The narrow ravines have a dense growth of *Berberis, Cotoneaster, Andromeda, Wikstroemia canescens,* and amongst these *Viburnum stellulatum* var. *glabrescens,* which was in fruit, was the tallest. In partly exposed places which get some sunlight were species of *Impatiens, Valeriana hardwickii,* and *Satyrium nepalense.* In sunny situations grew in great profusion *Hypericum patulum* and *Swertia angustifolia* var. *pulchella. Campanula colorata* was to be seen everywhere.

From Chaubas to Risingo the track ascended to 2290 m. and *Rhododendron arboreum, Andromeda elliptica, Cotoneaster thymifolia,* and *Berberis* became very common. At certain places the ground was covered entirely by *Wikstroemia canescens,* which with its yellow flowers added to the beauty of the landscape. Near Risingo there is again very heavy cultivation and we passed through cultivated terraces. Risingo is famous for its old Gompha, and from the carvings on the woodwork of the old ' pati ' it was clear that ' tantrik ' influence had penetrated so far east. After Risingo I have not seen any other place that bears signs of 'tantrik ' influence. All along I noticed that in the hamlets bananas and cucumbers are great favourites and are cultivated wherever possible. I crossed the Manga Deorali at 2,440 m. The two sides of Manga Deorali have a vegetation similar to that of Chaubas and Risingo but *Ilex* sp. is in profusion ; *Rubus paniculatus* is an addition, and *Rhododendron arboreum* grows to its normal size. Human habitation is scanty and as such the trees are saved from the axe. As we descend to Charikot, we pass through a belt of *Castanopsis. En route* there were a number of species of *Impatiens, Serissa foetida,* and in marshy places *Utricularia*


TIBET
SIKKIM
INDIA
Namchee
Walangchungola
Topkagola
Taplejung
Tamur
Arun
Chainpur
Ilam
Dhankuta
Bhojpur
Aisvalukherka
Okhaldunga
Charikot
Thosé
Ramechappe
Kathmandu
Chisapanigarhi
Amlekhgunj
Sun kosi
Udaipur Ghari
Sapt kosi
Hanumannagar
Biratnagar
Jhapa
29002
27790
28146
24000
12400
18900
10380
11500
11800
13600
8000
14900
10300
22800
19550
12500
18800
6700
7011
86
87
88
85
28
27
Watershed:
Scale: 1in. = 25 miles
Route:

EAST NEPAL

Figures along broken lines indicate height in feet above sea-level

bifida. At lower altitudes, where *Agave* grew, *Aeginetia indica* was very common. While crossing the Manga Deorali we encountered leeches of two varieties and every one caused profuse bleeding. After five days' trek, I was in Charikot which is one of the sub-districts. I had a day's halt and the time was spent in changing the driers, purchasing rations, and attending to the much needed washing.

To Kalinchok

Kalinchok is one of the pinnacles of the range that separates the Sun Kosi watershed from the Bhotea Kosi watershed. The range is sparsely populated and is visited by herdsmen who camp there during the summer months. The only other visitors are pilgrims to the Kali temple situated at the top, which is 3,815 m. above sea-level. This area was also visited in 1952, but before the rains. The vegetation up to 2,295 m. is composed of poor specimens of *Gaultheria fragrantissima, Viburnum erubescens, Andromedia elliptica, Rosa sericea,* and *Berberis wallichiana*; *Castanopsis hystrix* was seen only at a few places, similarly *Melastoma* sp. was noted as scattered. In the ravines *Symplocos theaefolia* was in great abundance, and in places there were pure formations of the species. Higher up, species of *Quercus* appeared in places, *Ilex* and later on the tree species *Pinus wallichiana* and *Tsuga dumosa* became the predominant species. The ground was covered with herbs, many of which were not in flower. The species that were in flowering state were *Geranium nepalense*, the trailing blueflowered *Parochetus communis*; *Crawfurdia speciosa* also with blue flowers, *Ranunculus diffusus*, species of *Impatiens*, and *Edgaria darjeelingensis*, which had just started flowering; *Aconitum laciniatum* was found growing under shade and it was plentiful, so also was *Allium wallichii.* My porters could only inform me that this blue-flowered *Allium* has some medicinal properties. In exposed sunny situations *Swertia angustifolia* var. *wallichii* and *Anemone vitifolia* added to the flowering species. As I climbed to about 3,360 m. the number of species in flower increased; along the slopes grew *Corydalis casimiriana, Heracleum sublineare, Thalictrum chelidonii, Microglossa albescens, Saxifraga brachypoda* var. *fimbriata, Saxifraga strigosa, Saxifraga nutans, Cynanthus linifolius, C. lobatus, Pedicularis gracilis*, and many others. In the open grew gregariously *Dipsacus inermis, Senecio graciliflorus*, and *Swertia dilatata.* Occasionally appeared *Cremanthodium oblongatum, Lactuca macrantha, Primula glomerata*, and *Pedicularis longiflora*; for *Parnassia nubicola* the flowering period was over, as many were in fruit. At about 3,665 m. small groves of *Rhododendron* species appear, and form the principal species along with *Abies.* The top of the ridge is a wide flat traversed by a number of small streams coming down from the pinnacle. The grassy flat is dotted with *Polygonum viviparum* with pink flowers, blue-flowered *Primula glomerata, Cremanthodium oblongatum, Aster tricephalus,* and *Swertia dilatata.* Along the sides of the small streams *Corydalis casimiriana* grows in profusion. Along the slopes near the top *Rhododendron campylocarpum, R. campanulatum,* and *Abies* grow but far apart. On the northern slopes *R. setosum* and *R. lepidotum* grow. After staying in the area for four days I returned to Charikot.

CHARIKOT TO JUNBESA

For most of this part of the journey I was in the cultivation belt, where forests have been reduced to scrub. Wherever the altitude was about 1,830 m., *Rhododendron arboreum, Pinus wallichiana, Symplocos theaefolia,* and *S. ramosissima* appeared. The range known as Hanumanthe, which is 3,114 m., was crossed at about 2,442 m. The predominant species is *Ilex* which is densely covered with festoons of lichens. The lop-sided appearance of the trees gave evidence to the direction of the prevailing winds. In this area *Impatiens* species seemed to be very abundant ; the commoner plants noticed were *Pedicularis gracilis, Elsholtzia blanda, Halenia elliptica, Campanula argyrotricha* ; on rare occasions I noted specimens of *Chirita urticaefolia, Lobelia pyramidalis,* and *Astilbe rivularis.*

After two days I reached Those where there are iron mines. The village of Those is on the banks of Khimti Khola, which is a perpetual stream. All around Those there are neither forests nor even small groves. The forests have been cleared to make charcoal to be supplied to the smithies. Herds of cattle graze along the banks of Khimti ; above Garjan towards Panchpokhri and Jatapokhri there are extensive grazing fields for the *chumries.* It is this area that supplies ghee to the capital. I halted at Those for a day and attended to the collection and other necessaries. Leaving Those I moved along the banks of Khimti Khola for some distance, then ascended the Tambe Danda. This range was crossed at about 2,900 m. and this day's travel was very unpleasant. No other day did we have such heavy rain accompanied with strong wind as on this day ; shelter under boulders and ledges proved futile, and it was decided to continue the trek. We were later enveloped in a thick mist and were chilled to the bones. All along it was noticed that *Polygonum paniculatum* was in abundance and covered most of the trees and shrubs that we passed. *Impatiens falcifera* and *I. racemosa* were two common species. As I descended to Bhandara (also known as Chyangma) I found *Campanumea inflata* twining all over. Next day under a clear sky I saw the village of Bhandara, with its beautiful broad terraces all under potato cultivation.

The Lamjura Bhanjyang stood between us and Junbesa. This range was crossed at 3,815 m. ; on both the faces the vegetation is very dense and the forest is virgin. Lumbering has not been attempted and grazing is very little. The principal tree species are *Ilex fragilis*, *Acer campbellii*, *A. papilio*, *Sorbus folioloso Rhododendron arboreum*, *R. barbatum*, *R. campylocarpum*, *R. campanulatum*, and another species of *Rhododendron* that was not in flower and could not be recognised. *Symplocos* was in the ravines at lower altitude. The commonest shrubs were *Viburnum* sp., *Berberis wallichiana*, *Daphne*, *Piptanthus nepalensis*. Above 3,055 m. *Tsuga dumosa* appeared and did not contribute much to the forest composition. Big clumps of *Osmunda claytoniana* were very common. The ground was sparsely covered with herbs as compared to Kalinchok ; *Fragaria* and *Androsace* were in fruiting stage, a number of species of *Impatiens* were seen, *Pedicularis regeliana*, *Desmodium parviflorum*, *Lespedeza formosa*, *Bupleurum tenue* were common herbs. *Gentiana ornata*, which so far has been rarely seen in this tour, was in great profusion here ; species of *Saxifraga* and *Corydalis casimiriana*, which were so common and abundant at Kalinchok, were much less here. Although the number of species was more or less the same at the two places, yet there were some striking differences. Kalinchok was richer in *Tsuga* and *Abies*, whereas Lamjura is richer in Rhododendrons. Kalinchok had more species in flower than Lamjura. There were some species that were seen only at Lamjura, such as *Acer campbellii*, *A. papilio*, *Ilex fragilis*, and *Sorbus foliolosa*. I failed to notice *Symplocos* along the slopes of Lamjura.

As we moved along the top of the ridge for nearly three miles we were in a pure Rhododendron forest. In open sunny situations grew *Juniperus recurva* and a *Cotoneaster* ; on rocks and boulders *Gaultheria trichophylla* and *Stellaria sikkimensis* formed a thick cover ; *Gaultheria* was in fruit. *Cynanthus hookerii* was a rare plant and a thorough search yielded not many specimens. Similarly *Meconopsis nepalensis* with its blue flowers was extremely rare and only one specimen was in flower, all the others were in fruit. On the eastern face of Lamjura *Rosa sericea* and *Berberis* spp. were abundant. This day also ended by drenching us. Junbesa is a sherpa village on the banks of Beni khola, that rises from the foot of Nambur. All around the slopes are densely clothed with *Pinus wallichiana*, and higher up by *Tsuga dumosa*. To the north of the hamlet stands Nambur 7,045 m., and a little to the east Karyolung 6,720 m. Below Junbesa begin wide grazing fields. The surroundings of Junbesa are simply magnificent and under the full moon they are gorgeous ; but it was an unauspicious time when we stepped into the village. We could get no shelter, and it was raining ; the lodging that we finally managed to get had much to be desired. After a warm meal we crept into our beds, but were soon up again ; as I flashed my torch I was amazed to find vermin of all sizes and sorts around us. An entomologist would have had a very busy time and made a marvellously fine collection by daybreak, but insects in the night soon get on the nerves of a tired botanist.

JUNBESA TO OKHALDUNGA

From Junbesa the track to Phaplu passed through a fine and extensive pine forest. Pure formations of *Pinus wallichiana* covered all the slopes. Higher up, however, there was *Tsuga dumosa*. The broad terraces, which are under potato cultivation, are bordered by *Prinsepia utilis*. All around Phaplu there are pine groves. In exposed sunny situations the principal shrub is *Piptanthus nepalensis* which at this time of the year was in fruit. *Drosera lunata* was found at many places and it seemed as if it was being cultivated. Along the many streams and springs I collected a number of liverworts. This hamlet being a sherpa one there are many gomphas and in the compounds *Cryptomeria japonica* is planted. For the next two days we were in the cultivation belt ; on sunny grassy slopes grew *Potentilla fulgens*, *P. kleiniana*, *Anaphalis contorta*, and *A. triplinervis*, occasionally a specimen of *Epilobium wallichianum* was seen. *Berberis* and *Prinsepia* were in abundance. At Pakernasa I observed a dense grove of walnut trees, a wild variety var. *kumaonica* ; its fruits are smaller with a thick shell. The Tilbung ridge 3,290 m. has very sparse vegetation. It is only in the ravines that a dense association of *Acer*, *Ilex*, *Rhododendron*, and higher up *Pinus*, and *Tsuga*, occur. Over the vast grassy slopes graze herds of *chumries*. *Potentilla* and *Anaphalis* dot the slopes all over. Here I collected fine flowering specimens of *Epilobium wallichianum* Along the sides of the track, where the humidity and moisture was high, *Osmunda* and *Lycopodium* were in plenty. On the windswept ridges *Ilex* with its lop-sided branching, densely covered with festoons of lichens, was the only tree species ; of shrubs we noted *Rosa*, *Berberis*, and *Andromeda* ; *Viburnum* was but rarely seen. Between 1,220 m. and 1,985 m. *Eupatorium glandulosum* is found in great abundance. This species has great adaptability and grows everywhere ; the weed is encroaching on the terraces under cultivation and is now a menace to the cultivators. This weed is locally known as *ban mara*, for it does not allow any other species to grow. They also call it *Congress lahara* because it is said that this weed appeared after the Congress rose in the country. It is in and around Okhaldunga that this weed has attained its greatest and most extensive distribution.

OKHALDUNGA TO KATHMANDU

At Okhaldunga we had a day's halt. Here the porters fell out amongst themselves and a day was wasted in getting official help to straighten out matters. From Okhaldunga to Ramechappe the distance was covered in six days. We were in a heavily cultivated area. All natural vegetation has disappeared, and in the hamlets the cultivated trees are *Bauhinia*, *Psidium*, and apple. *Schima wallichii*, which is a very prominent tree of Nepal and found everywhere between 1,065 m. to 1,525 m., is the only tree species that is found near hamlets. Far away from hamlets small groves of *Castanopsis* are seen ; for fuel requirements the villagers have to cover long distances. The area is heavily cultivated and equally heavily eroded. The old discarded cultivation terraces have slid at innumerable places—one of the landslides was so big that it checked the course of a stream. At lower altitudes *Rhus parviflora*, *Ostodes paniculata*, *Phyllanthus emblica*, and *Gleichenia* were seen. For most of the time now we were travelling at 1,220 m. Of the herbs *Biophytum reinwardtii*, *Sonerila stricta*, *Drymaria cordata*, *Lindenbergia indica* were very common. In the pine forests *Striga euphrasioides*, *Osbeckia truncata*, *Echinacanthus attenuatus*, and *Spermacoce stricta* were commonly met with. Over the ridges and along the slopes *Desmodium dioicum* was the only species ; under a strong sun this shrub provided shade at some places. In this area I noticed *Homalium nepalense* to be quite frequent. We descended further and moved at 763 m. for two days. All along *Aegle marmelos*, shrubs of *Zizyphus mauritiana*, *Jatropha curcas*, and *Anona* were seen. The drab appearance of the surroundings was occasionally changed by *Woodfordia* with its old leaves that have a rose-pink colour. We had plenty of *Psidium guayava* fruits on the way. Near Chaukot a beautiful *Impatiens* with mauve flowers and a long spur was collected ; this balsam has been identified as *I. prainii*. I was back in Banepa on the 6th October 1956, and a day later reached Kathmandu. The total collection comprised 169 species of flowering plants belonging to 123 genera out of 51 families.

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ENUMERATION OF PLANTS COLLECTED

Appended is the list of plants collected during the tour. The sequence of families followed in the following pages is that of Bentham and Hooker with some modifications.

The vegetation being predominantly east Himalayan, the west Himalayan elements have been marked as †, and species that form a continuous line of distribution are marked as ‡. The new records for E. Nepal have been marked as *.

RANUNCULACEAE

Aconitum laciniatum Stapf

Roots tuberous, 2 or 3 tubers ; stems robust ; leaves 5-7-lobed nearly to the base ; flowers blue. Abundant in shade at 2,750 m. (B. 1025).

Anemone vitifolia Buch.-Ham. ex D. Don

Stems robust, white pubescent ; flowers creamy white. Abundant in shaded and moist places, at 1832 m. (B. 1029, 1117).

Delphinium vestitum Wall. ex Royle

A herb with radical orbicular leaves ; flowers dull blue. Common in the shade at 3,360 m. (B. 1005).

Ranunculus diffusus DC.

Stem decumbent, covered with soft spreading hairs. Flowers bright yellow. Common in open places, from 1,832 m. to 2,750 m. (B. 1018, 1032).

Thalictrum chelidonii DC.

Much branched herb. Leaflets orbicular-cordate. Flowers blue. Abundant at 3,360 m. (B. 1007).

FUMARIACEAE

Corydalis casimiriana Duthie & Prain

Prostrate herb. Leaves pinnately divided, leaflets 3-5, deeply lobed. Flowers yellow, tip dark purple. Abundant along slopes at 3,360 m. (B. 1001).

Dicentra thalictrifolia Hk. f. & Th.

Stem slender and angled. Flowers not seen. Capsule fleshy. Rare. Specimen collected at 2,135 m. (B. 1077).

PAPAVERACEAE

Meconopsis nipalensis DC.

An erect herb about 2 m. tall. Leaves pinnatifid, densely covered with golden hairs. Flowers 5-6 cm. in diam. ; red purple. Ovary densely covered with hairs. Only one specimen, collected at 3,665 m. (B. 1063).

FLACOURTIACEAE

Homalium nepalense Benth.

Shrub with glabrous leaves, panicles with divaricate branches minutely tomentose. Flowers pale white, small. Abundant at 1,220 m. (B. 1098).

POLYGALACEAE

Polygala persicariaefolia DC.

Pubescent. Stem erect ; leaves sub-sessile. Flowers pink. Rare. Specimens collected at 1,375 m. (B. 1084).

Polygala triphylla Buch.-Ham. ex D. Don

Stem weak, nearly erect. Flowers deep pink in erect terminal racemes. Very common in grass at 1,065 m. (B. 930).

Salomonia cantoniensis Lour.

Diffuse herb. Stem winged. Spikes rather lax. Flowers blue. Occasional at 1,375 m. (B. 1088).

CARYOPHYLLACEAE

Drymaria cordata Willd. ex Roem. & Schultz.

Diffuse, much branched herb. Flowers white ; petals equalling the sepals. Very common at 1,525 m. (B. 1094, 1110).

Sagina procumbens Linn.

A very small herb. Stem tufted, bright green. Flowers small, white. Common amongst rocks and crevice at 1,830 m. (B. 1081, 1124).

***Stellaria sikkimensis** Hk. f.

Herb forming matted tufts. Flowers white. Rare. Collected at 3,664 m. (B. 1058).

HYPERICACEAE

Hypericum elodeoides Choisy

Stem terete, stoloniferous. Bracts with stalked glands. Flowers yellow in terminal panicles. Sepals and petals black-dotted. Abundant at 1,985 m. (B. 964).

Hypericum patulum Thunb.

Branched shrub spreading pyramidally ; branches 2-ridged. Flowers bright yellow. Common at 1,985 m. (B. 966).

TILIACEAE

Triumfetta pilosa Roth

Herbaceous, bristly, bristles bulbous. Lower leaves 3-lobed, upper generally ovate, stellate hairs on both surfaces. Flowers yellow. Capsule covered with long hooked spines. Common at 915 m. (B. 973).

GERANIACEAE

Geranium nepalense Sweet

Stem prostrate, diffuse, softly hairy. Flowers purple ; petals notched. Common at 1,025 m. (B. 943).

Geranium sp.

Stem prostrate, branches long. Flowers blue, 3½ cm. in diam. ; sepal tips pointed, margin membraneous, hairy. Common. Specimens collected at 2,750 m. (B. 1021).

OXALIDACEAE

Biophytum reinwardtii Walp.

Stem simple. Leaflets 10-20 pairs. Flowers orange-yellow. Capsules equalling the sepals. Abundant in the open at 1,525 m. (B. 1090).

BALSAMINACEAE

***Impatiens arguta** Hk. f. & Th.

Stem erect. Leaves all alternate. Flowers white, of medium size. Sepals 4 ; lip spurred. Occasional at 1,985 m. (B. 965).

I. bicornuta Wall. ex Roxb.

Flowers rose-purple. Sepals minute, orbicular, gland tipped. Lip sigmoidly incurved. Rare. (No number).

I. discolor DC.

Leaves all alternate. Inflorescence of spreading peduncled few flowered racemes. Flowers white with a violet tint. Sepals entire, margins eglandular. Occasional at 1,985 m. (B. 956).

***I. falcifera** Hk. f.

Leaves all alternate, serrate. Inflorescence much shorter than the leaves. Flowers yellow ; basal lobe of wings very small, distal much broader than long. Common from 1,832 m. to 3,350 m. (B. 1006, 1048, 1056, 1119).

***I. laevigata** Wall. ex Hk. f.

Glabrous shrubs. Leaves alternate, also opposite. Flowers large ; bracts large, herbaceous. Sepals 4. (No number).

I. prainii Hk. f.

Leaves all alternate, linear-lanceolate. Inflorescence of spreading few-flowered racemes. Flowers rose-pink ; sepals entire. Occasional at 1,680m. (B. 1107).

***I. radiata** Hk. f. & Th.

Leaves alternate. Flowers small, yellow ; flower buds globose, plane of mouth of expanded flower horizontal. Common at 1,985 m. (B. 955).

I. racemosa DC.

Leaves alternate. Flowers small, yellow. Flower buds exclusive of spur globose. Abundant at 1,068 m. (B. 984).

I. uncipetala C. B. Clarke (=**I. scabrida** Wall. p.p.)

Leaves all alternate. Inflorescence much shorter than the leaves. Flowers bright yellow. Basal lobe of wing spurred in the sinus. Rare. Specimens collected at 2,440 m. (B. 1113).

I. sulcata Wall.

Leaves opposite or pseudo-verticillate. Flowers of medium size, rose-purple. Bracts broad. Basal lobe of wings spurred. Lip saccate. Rare. Specimens collected at 3,055 m. (B. 1014).

MELIACEAE

Cipadessa baccifera (Roth) Miq. (=**C. fruticosa** Bl.)

Small tree. Panicles with long peduncles. Flowers white. Fruits scarlet. Common at 916 m. (B. 971).

AQUIFOLIACEAE

***Ilex fragilis** Hk. f.

A small tree with brittle branches. Leaves deep green, membraneous. Fruits red. Collected in fruit at 3,665 m. (B. 1061).

VITACEAE

Tetrastigma serrulatum Planch. (=**Vitis capriolata** D. Don)

A large climber with leaves 5-foliate. Very common all over the area traversed.

SAPINDACEAE

Cardiospermum halicacabum Linn.

Climbing glabrous herb. Flowers small, white in long stalked corymbs having a pair of coiled tendrils at the base. Capsule globose, 3-cornered. Common at 1,220 m. (B. 1103).

ACERACEAE

***Acer campbellii** Hk. f. & Th. ex Brandis

A tall tree. Leaves deeply cut, 5-7-lobed, glabrescent; petioles reddish. Flowers white. Occasional at 3,665 m. (B. 1064).

***A. papilio** King

A medium sized tree found above 3,054 m. Leaves palmate, 5-7-lobed, soft and often hanging downwards. Abundant at 3,665 m. (B. 1065).

ANACARDIACEAE

Rhus parviflora Roxb.

A shrub covered with red-brown tomentum. Flowers yellow-green in hairy terminal panicles. Very common, forming a scrub at 916 m. (B. 937).

R. javanica Linn. (= **R. semialata** Murr.)

Tree, common in old cultivations. Leaves pinnate, leaflets tomentose below. Flowers yellow-green. Occasional. (No number).

PAPILIONACEAE

Atylosia mollis Benth.

Shrub, densely tomentose. Stems long and twining. Flowers yellow. Occasional at 1,375 m. (B. 1083).

Crotalaria albida Heyne ex DC.

A small prostrate undershrub. Flowers pale yellow ; petals equalling sepals. Common at 916 m. (B. 938).

Crotalaria evolvuloides Wight ex. Wt. & Arn.

Stem usually ½ m. ; much branched, finely silky. Leaves shortly stalked. Flowers yellow. Common above 1,830 m. (B. 1068).

Desmodium dioicum (Buch.-Ham.) DC.

A small shrub with blue flowers. Abundant along slopes at 1,220 m. (B. 1104).

D. floribundum Sweet

Erect shrub, densely pubescent. Flowers blue in densely crowded racemes ; bracts large. Common at 1,985 m. (B. 951).

D. microphyllum DC. (= **D. parvifolium** DC.)

A small shrub with stem tufted. Leaflets ovate. Flowers purple; calyx densely hairy. Abundant between 916 m. and 3,665 m. (B. 935, 1045, 1054).

D. oxyphyllum Prain [= **D. racemosum** (Thunbg.) DC.]

Small scandent shrub. Flowers light violet. Occasional at 1,985 m. (B. 950).

D. triflorum (Linn.) DC.

A small shrub with prostrate stem. Leaflets obovate. Flowers bright blue. Common in open grassy situations at 1,985 m. (B. 962).

Eriosema chinense Vogel

Stem generally ½ m.; woody. Leaves 1-3-foliate. Flowers rose-pink. Rare. Specimens collected at 916 m. (B. 939).

Lespedeza stenocarpa Maxim

Shrubby, densely pubescent. Leaflets obovate, upper surface nearly glabrous, lower covered with white silky hairs. Flowers pink. Abundant in shade at 3,054 m. (B. 1055).

Parochetus communis Buch.-Ham. ex D. Don

A hairy herb; stem prostrate, rooting at the nodes. Flowers light purple. Occasional at 2,748 m. (B. 1020, 1120).

CAESALPINIACEAE

Cassia dimidiata Baker

Glabrous herb. Leaflets 50-100. Flowers yellow, axillary, solitary. Stamens 4 or 5. Rare at 1,220 m. (B. 970). This species is distinguished from *Cassia mimosoides* L. in having fewer stamens—*C. mimosoides* has 10 stamens; besides the flowers are in clusters of 2 or 3.

ROSACEAE

Agrimonia eupatorium Linn.

A hairy herb. Lower leaves with leaflets very unequal. Flowers yellow; bracts 3-cleft, bracteoles 3-toothed. Common at 1,832 m. (B. 1049).

Neillia thyrsiflora D. Don

Shrub with flowers light pink. Calyx with glandular hairs. Rare at 916 m. (B. 977).

Potentilla fulgens Wall. ex Hook.

Herb with robust stem. Leaves with lower surface silvery tomentose. Flowers yellow. Petals equalling the calyx. Abundant at 3,054 m. (B. 1071).

P. kleiniana Wt. & Arn.

Stem diffuse, spreading. Leaves with 3 or 5 leaflets. Flowers yellow. Common at 3,054 m. (B. 1072, 1112).

Prinsepia utilis Royle

Glabrous shrub. Spines often leaf-bearing. Flowers white. Abundant at 2,440 m. (B. 1066).

Rubus fockeanus Kurz

Stem procumbent. Leaflets not shining above. Flowers white. Abundant at 2,748 m. (B. 1023).

Sorbus foliolosa (Wall.) Spach. (= **Pyrus foliolosa** Wall.)

Small tree. Leaves and inflorescence covered with reddish tomentum. Abundant at 3,664 m. (B. 1062).

SAXIFRAGACEAE

Astilbe rivularis Buch.-Ham. ex D. Don

Herb erect, hairy. Flowers small, yellowish green in panicles. Rare at 1,832 m. (B. 1039).

Parnassia nubicola Wall. ex Wight

A glabrous herb with perennial rootstock. Flowers white ; petals entire or slightly jaggy. Rare at 3,522 m. (B. 990).

Saxifraga hookeri Engl. & Irms. (= **S. corymbosa** Hk. f. & Th.)

Stem 7 to 15 cm. Cauline leaves sessile, entire and clasping the stem. Flowers small, yellow. Only one specimen collected at 3,216 m. (B. 1127).

S. brachypoda D. Don var. **fimbriata** (Wall.) Engl. & Irms. (= **S. fimbriata** Wall. ex DC.)

Stem unbranched. Leaves lanceolate, shining. Flowers yellow. Abundant at 3,522 m. (B. 986, 1115).

***S. nutans** Hk. f. & Th.

Stem 12 to 20 cm. ; densely glandular. Radical leaves petioled, cauline sessile. Flowers yellow ; sepals with black glands. Common at 3,522 m. (B. 989).

S. strigosa Wall. ex Ser.

Stem 10 to 20 cm. ; rigid, whole plant strigote. Flowers white ; sepals slightly united. Abundant at 3,522 m. (B. 988, 1116).

MELASTOMACEAE

Osbeckia nepalensis Hk. f.

A small shrub with adpressed hairs. Petals 4. Rarely seen, at 916 m. (B. 931).

O. truncata D. Don ex Wt. & Arn.

Stem 10 to 30 cm. high ; 4-angled. Leaves elliptic, turning black on drying. Flowers purple, 1.2 cm. in diam. Abundant in open grassy situations in pine forests at 1,068 m. (B. 1102).

Oxyspora paniculata DC.

A very handsome shrub with flowers red or pink. Abundant at 916 m. (B. 978).

Sonerila stricta Hk. f.

Stem 15 to 30 cm. ; erect covered with long spreading hairs. Flowers purple. Abundant at 1,220 m. (B. 1093).

CUCURBITACEAE

Edgaria darjeelingensis C. B. Clarke

A large scandent herb; tendrils bifid. Flowers yellow. Occasional at 2,750 m. (B. 1017).

UMBELLIFERAE

Bupleurum tenue Buch.-Ham. ex D. Don

Herb 0.5 m. ; leaves sessile. Umbels on short lateral branches. Flowers white. Abundant at 1,068 m. extending up to 3,664 m. (B. 940, 1052).

Heracleum sublineare C. B. Clarke

Stem about 1 m. tall. Leaves bipinnate, pinnae lanceolate serrate. Flowers white, outer large ; petals pinkish at the base. Abundant at 3,360 m. (B. 1003).

***Oenanthe thomsonii** C. B. Clarke

Deep-rooted plants with stem weak and diffuse. Leaves 4-5-pinnate, 15 cm. long. Common at 1,527 m. (B. 942).

Pimpinella diversifolia DC.

Pubescent, stem about 1 m. Leaflets variable. Flowers white. Fruits roughly pubescent. Rare. Specimens collected at 2,440 m. (B. 1129).

***Pleurospermum apiolens** C. B. Clarke

Stem 2-50 cm. Leaves pinnate, pinnae pinnatifid with 3-7 lobes. Flowers white. Plants slightly aromatic. Rare. Specimens collected at 3,054 m. (B. 1011).

Selinum tenuifolium Wall. ex C. B. Clarke

Stem about 60 cm. tall. Leaves large, finely divided. Very aromatic. Common at 3,054 m. (B. 1013).

CAPRIFOLIACEAE

Viburnum stellulatum Wall. var. **glabrescens** C. B. Clarke

A large shrub. Leaves glabrescent except on the nerves beneath. Corymbs terminal, with a few hairs. Flowers white; fruits reddish. Very common between 1,375 m. and 1,985 m. (B. 946, 948).

RUBIACEAE

Galium hirtiflorum Req.

Stem weak, shining. Leaves in whorls of 4. Flowers minute, red. Abundant 1,375 m. (B. 945).

Spermacoce stricta Linn.

Herb 15 to 30 cm.; branched. Inflorescence dense flowered. Flowers minute. Abundant at 1,375 m. (B. 1087).

VALERIANACEAE

Valeriana hardwickii Wall.

Rootstock slightly thickened, fibrous. Leaves pinnate, leaflets lanceolate. Flowers in axillary compound corymbs, white. Occasional at 1,985 m. (B. 957).

DIPSACACEAE

Dipsacus inermis Wall. ex Roxb.

Stout erect herb, prickly. Leaves opposite, pinnatifid. Flower heads several, flowers yellowish white. Abundant at 3,360 m. (B. 1004).

Triplostegia glandulifera Wall. ex DC.

Erect herb, glandular. Leaves pinnatifid. Flowers very small, light pink. Common at 3,054 m. (B. 1009).

COMPOSITEAE

Anaphalis contorta Hk. f.

Stem prostrate, branches woody below. Leaves cottony on both surfaces. Heads in dense corymbose clusters. Very common at 3,216 m. (B. 1079).

A. triplinervis C. B. Clarke

A robust plant densely clothed with white wool. Leaves cobwebby above, amplexicaul. Occasional at 1,985 m. becoming very common at 3,216 m. (B. 958, 1080).

Aster tricephalus C. B. Clarke

Stem erect, puberulous. Leaves obovate-spathulate, amplexicaul. Heads 1-3; florets blue. Achenes with red pappus. Occasional at 3,360 m. (B. 1000).

Chrysanthellum indicum DC.

Herb on shingly soil, prostrate. Flowers yellow. Rare at 1,220 m. (B. 929).

Cremanthodium oblongatum C. B. Clarke

A robust plant. Leaves 5-7 cm. in diam.; with coarsely reticulated nerves. Heads yellow. Abundant at 3,522 m. (B. 995).

Erigeron bellidioides Benth. ex C. B. Clarke

Herb, stem slender, grooved. Heads 1 cm. in diam.; few, purple. Common at 1,985 m. (B. 952).

Eupatorium glandulosum H. B. & K.

Herb with opposite leaves. Very well established on red soil. It has become very troublesome to the cultivators, as it encroaches into the cultivated terraces. Popularly known as ‘ ban mara ’. Noticed to be very luxuriant between 1,375 m. to 1,832 m. (B. 1097).

Inula nervosa Wall. ex DC.

Perennial pubescent, stem branched. Leaves sub-sessile. Heads mostly corymbose, florets light blue. Abundant at 2,135 m. (B. 1044).

***Lactuca macrantha** C. B. Clarke

Stem about 50 cm. tall, stout. Leaves pinnatifid. Heads nodding, florets blue. Abundant in shade at 3,360 m. (B. 996).

Microglossa albescens Benth. ex C. B. Clarke

A stout erect herb. Leaves shortly petioled, hoary beneath. Heads 1 cm. in diam., loosely clustered; florets blue; pappus red. Abundant at 3,054 m. (B. 1010).

Myriactis wallichii Less. ex DC.

Erect herb, roughly hairy. Leaves ovate or lanceolate, coarsely toothed. Heads minute. Ray florets white, disc florets yellow. Occasional at 2,440 m. (B. 1070).

Senecio alatus Wall. ex DC.

Stem short or long, pubescent. Leaves ovate, petiole winged. Heads many, forming terminal panicles. Flowers yellow. Common in shade at 3,054 m. (B. 1015).

S. graciliflorus DC.

Stem about 1 m. tall, grooved. Leaves membranous, pinnately lobed. Heads numerous, drooping; florets yellow. Gregarious at 3,522 m. (B. 991).

Vernonia teres Wall. ex DC.

Stem rigid, scabrid. Leaves obovate or obovate-lanceolate, scabrid on both surfaces. Florets all tubular, purple. Occasional in Pine forests at 1,068 m. (B. 1082).

CAMPANULACEAE

Campanula colorata Wall. (including **C. canescens** & **C. cana**)

Stem hairy or tomentose. Leaves lanceolate, sessile. Flowers many in panicles, pale lilac, or white. Occasional from 1,680 m. to 2,443 m. (B. 963, 1111, 1128).

C. argyrotricha Wall. ex DC.

Stem procumbent, hairy. Leaves sessile, toothed, or nearly entire, softly silvery hairy. Flowers blue, long stalked; corolla deeply lobed. Occasional at 1,832 m. (B. 1041).

***Campanumaea inflata** C. B. Clarke

Stem slightly twining. Leaves alternate or opposite, deeply cordate. Flowers light blue, evil smelling. Rare. Specimens collected at 2,443 m. (B. 1047).

Cynanthus hookeri C. B. Clarke

Stem 8-10 cm. high, many branches from one root. Leaves ovate, hirsute. Specimens collected in fruit. Rare at 3,664 m. (B. 1057).

†**C. linifolius Wall.** ex C. B. Clarke

Herb, 8-30. cm.; sparsely hairy. Leaves sessile, oblong, margins slightly recurved. Flowers blue. Abundant along slopes at 3,522 m. (B. 992).

C. lobatus Wall. ex Benth.

Deep-rooted, prostrate stem glabrous below, hairy above. Leaves with a very short petiole, pilose. Flowers blue, corolla hairy at the throat. Very common along slopes at 3,522 m. (B. 994).

Lobelia succulenta Bl. (= **L. affinis** Wall.)

Stem prostrate, much branched, pubescent. Leaves ovate, pilose on the nerves. Flowers pink. Common at 1,525 m. (B. 1092, 1109).

L. pyramidalis Wall.

Stem robust, much branched, hollow. Leaves linear-lanceolate, upper leaves sessile. Flowers pinkish-purple. Rare. Specimens collected at 2,440 m. (B. 1033).

ERICACEAE

Andromedia formosa Wall. (= **Pieris formosa** D. Don)

A small tree with leaves lanceolate, acuminate. Flowers white. Common at 2,443 m. (B. 976).

Gaultheria trichophylla Royle

Small prostrate rigid shrub. Stem hirsute ; leaves sessile, long hairs on the margins. Flowers red or pink. Abundant at 3,665 m. (B. 1051).

SYMPLOCACEAE

Symplocos theaefolia D. Don

A tall tree about 15 m. tall. Leaves oblong-lanceolate, faintly serrulate, coriaceous. Flowers yellowish white. Abundant at 2,290 m. (B. 1026).

GENTIANACEAE

Crawfurdia speciosa Wall.

Twiner ; leaves opposite, base cuneate. Flowers blue. Common at 2,748 m. (B. 1019).

Gentiana ornata Wall. ex Griseb.

Root elongate, branches many and curved. Flowers blue ; corolla funnel-shaped. Occasional at 3,665 m. (B. 1059, 1126).

Halenia elliptica D. Don

Erect glabrous herb, stem 4-angled, slightly winged. Flowers pale blue ; corolla lobe produced downwards into a straight spur. Abundant at 2,443 m. (B. 1037).

Swertia angustifolia Buch.-Ham. ex D. Don

Stem ½ to 1 m. tall, branched, narrowly winged. Leaves linear-lanceolate. Flowers yellow. Calyx and corolla 4-lobed, corolla with one gland on each lobe. Common from 1,374 m. to 1,985 m. (B. 928, 953).

S. angustifolia var. **pulchella** Burkill

Plants about 30 cm. tall. Sepals shorter than the petals. Abundant at 1,965 m. (B. 954, 1121).

S. angustifolia var. **wallichiana** Burkill

Plants tall. Sepals linear-lanceolate, exceeding the petals or equalling them, very conspicuous. Common at 1,832 m. (B. 1028).

S. dilatata C. B. Clarke

Stem about ½ m. tall. Leaves lanceolate, glabrous. Flowers blue. Calyx and corolla 5-lobed ; corolla shorter than calyx. Corolla with a complete ring at its base, one gland on each lobe. Abundant at 3,360 m. (B. 998).

S. nervosa Wall. ex Griseb.

Stem ½ to 1 m. tall, 4-angled, slightly winged. Leaves elliptic-lanceolate. Flowers yellowish green. Calyx and corolla 4-lobed ; corolla much smaller than the calyx. Corolla purple-dotted, one gland on each lobe, large. Rare at 1,068 m. (B. 980).

S. purpurascens Wall.

Stem ½ to 1 m. tall, branches spreading. Leaves oblong. Flowers purple ; calyx and corolla 5-lobed ; corolla bigger than calyx ; corolla with a dark complete ring at its base ; one gland on each lobe. Common at 2,748 m. (B. 979, 1024).

CONVOLVULACEAE

Ipomaea eriocarpa R. Br.

Hairy twiner ; leaves lanceolate, deeply cordate. Flowers small, pink. Common at 610 m. (B. 1106).

I. quamoclit Linn.

A slender glabrous twiner. Leaves pinnate, segments numerous, linear. Flowers crimson. Abundant at 916 m. (B. 927).

Porana stenoloba Kurz

An extensive pubescent climber. Leaves shallowly cordate, minutely hairy. Flowers blue. Rare. Specimens collected at 2,137 m. (B. 1076).

SCROPHULARIACEAE

Melasma arvense (Benth.) Pennell (= **Alectra indica** Benth.)

Erect rigid herb, scabrid. Leaves sessile, ovate-lanceolate. Flowers yellow, bracts longer than the flowers. Rare at 1,070 m. (B. 985).

Lindernia anagallis (Burm.) Pennell (= **B. veronicaefolia** Spr.)

Stem creeping, branches long and slender. Leaves oblong-lanceolate. Flowers light blue. Occasional at 1,220 m. (B. 1125).

L. ruelloides (Colsm.) Mukerjee (= **Bonnaya reptans** Spr.)

Prostrate creeping herb. Leaves in distant pairs. Flowers light purple. Occasional at 1,527 m. (B. 1091).

Lindenbergia grandiflora (Buch.-Ham.) Benth.

A half climbing rambling herb, softly hairy. Leaves pubescent on both surfaces. Flowers bright yellow. Rare. Specimens collected at 1,975 m. (B. 982).

L. indica (L.) O. Ktz. (= **L. urticaefolia** Lehm.)

Stem 10-20 cm. high, branched, hairy. Leaves broadly ovate, crenate-serrate. Flowers yellow. Occasional at 1,375 m. (B. 1095).

L. ruderalis Voigt

Pubescent herb with aromatic odour. Leaves ovate. Flowers blue. Occasional at 1,375 m. (B. 1096).

Pedicularis bifida (Buch.-Ham.) Pennell (= **P. carnosa** Wall.)

Herbs roughly pubescent. Leaves alternate, oblong, crenate. Flowers pink-purple. Occasional at 1,832 m. (B. 1036).

P. gracilis Wall. ex Benth.

Stem much branched, with 4 lines of hairs. Leaves whorled, pinnatifid. Flowers pink-purple ; calyx irregularly toothed ; corolla tip straight. Occasional at 2,443 m. and abundant at 3,054 m. (B. 987, 1035, 1114, 1122).

P. longiflora Rudolph

Stem 3-20 cm. ; hairless ; radical leaves many, pinnately cut. Flowers rose-pink ; bracts leafy ; corolla tube 4-5.5 cm. Occasional at 3,360 m. (B. 1002).

P. regeliana Prain

Small, rhizomatous stem ; leaves pinnatesect, segments 4-7 pairs. Flowers axillary, long pedicellate, purple. Posterior corolla lobe 3-lobuled, lobes rounded. Rare at 3,665 m. (B. 1053).

Striga euphrasioides (Vahl.) Benth.

Scabrid herb ; leaves linear. Flowers white and distant. Common at 1,527 m. (B. 1086).

OROBANCHACEAE

Aeginetia indica Linn.

Parasite ; scapes several, 15-30 cm. with a few scales at the base. Flowers solitary, corolla purple. Abundant on the roots of *Agave* at 1,068 m. (B. 947).

LENTIBULARIACEAE

Utricularia bifida Linn.

Small herbs, scape 5-10 cm. erect. Flowers solitary, yellow ; lower lip of corolla 0.5 cm., spur curved. Occasional at 1,220 m. in rice fields. (B. 969).

GESNERIACEAE

Chirita urticaefolia Buch.-Ham. ex D. Don

Stem 20-40 cm. ; upper part hairy. Leaves opposite, unequal. Flowers purple, corolla funnel-shaped. Rare. Specimens collected at 1,832 m. (B. 1031).

Rhynchoglossum obliquum Bl.

A succulent herb, usually ½ m. tall. Leaves alternate, unequal sided. Flowers generally blue, rarely white ; corolla tube cylindric, contracted at the mouth. Occasional at 1,220 m. (B. 986).

ACANTHACEAE

Aechmanthera tomentosa Nees var. **wallichii** C. B. Clarke

Small shrub, stem and leaves glabrate, sparsely hairy. Flowers blue. Occasional at 916 m. (B. 983).

Echinacanthus attenuatus Nees

Erect herb, generally ½ m. tall ; pubescent upwards. Leaves broadly elliptic. Flowers dark purple. Common in pine forests at 1,070m. (B. 1101, 1108).

† **Strobilanthes atropurpureus** Nees

Stem 15-30 cm. tall ; pubescent ; older parts viscid, 4-angled. Flowers, blue ; corolla tube light blue or even white, curved, broadly dilated. Rare. In swampy places at 1,832 m. (B. 1118).

* **Tarphochlamys affinis** (Griff.) Brem. (= **Strobilanthes acrocephala** T. Anders.)

Shrubby ; stem hirsute. Leaves ovate, crenate, hirsute. Flower light purple. Abundant at 1,832 m. (B. 1043).

VERBENACEAE

Verbena officinalis Linn.

An erect glabrous herb. Leaves pinnatifid, upper leaves sessile, 3-partite. Flowers small, lilac. Occasional at 2,443 m. (B. 1069).

LABIATAE

Calamintha umbrosa Fisch. & Mey.

A small procumbent herb, laxly hairy. Leaves ovate, serrate. Flowers in axillary whorls, light blue. Common at 2,139 m. (B. 1078).

Coleus forskohlii Briq. (= **Coleus barbatus** Benth.)

Herb 30-60 cm. high. Leaves ovate or obovate, densely pubescent on both surfaces. Flowers blue. Occasional at 916 m. (B. 972).

Colquhounia coccinea Wall. var. **vestita** Prain

Erect or semi-scandent about 1½ m. tall ; densely tomentose. Flowers orange-yellow. Abundant at 2,440 m. (B. 1022, 1075).

Elsholtzia blanda Benth.

Undershrub, puberulous. Leaves elliptic-lanceolate. Flowers white, sweet smelling. Abundant at 2,440 m. (B. 1034).

E. polystachya Benth.

Bushy plants, branches hoary tomentose. Leaves lanceolate or elliptic-lanceolate. Flowers light yellow, fragrant. Common at 3,054 m. (B. 1016).

E. strobilifera Benth.

Herbs small ; leaves ovate, sparsely hairy on both surfaces. Flowers pinkish. Occasional at 3,664 m. (B. 1060).

Geniosporum coloratum (D. Don) Briq. (= **G. strobiliferum** Wall.)

Erect herbs 60-100 cm. high, puberulous. Flowers white ; corolla with purple veins. (No number, no data).

Micromeria biflora Benth.

Small herb with tufted stiff branches. Leaves sessile, ovate or oblong. Flowers purplish. Common on grassy slopes and meadows above 1,985 m. (B. 961).

Plectranthus striatus Benth. var. **graciliflora** (Hk. f.). Mukerjee

Small herb, pubescent ; leaves scabrid. Flowers purple. Occasional at 1,525 m. (B. 1036, 1085).

Scutellaria discolor Coleb.

Creeping rootstock bearing erect branches. Leaves broadly elliptic. Flowers pale blue. Occasional at 916 m. (B. 932).

Stachya melissaefolia Benth.

Slender erect herb, tomentose. Leaves sessile, ovate or oblong. Flowers pink. Occasional at 3,054 m. (B. 1012).

POLYGONACEAE

Polygonum paniculatum Bl.

Tall scandent shrub, branches flexuous. Leaves elliptic ovate. Flowers white in large panicles. Abundant at 2,440 m. becoming occasional at 3,360 m. (B. 1008, 1046).

P. viviparum Linn.

Rootstock woody, stem 8-22 cm. ; slender. Leaves coriaceous. Spikes erect, solitary ; flowers pink. Abundant in open grassy slopes at 3,522 m. (B. 993).

LAURACEAE

***Neolitsea zeylanica** (Nees) Merr.

A small tree with leaves elliptic or elliptic-lanceolate, lateral nerves 2-4 on either side, nerves impressed. Occasional at 2,440 m. (B. 1067).

THYMELEACEAE

‡ **Wikstroemia canescens** Meissn.

Shrub about ¾ m. tall, silky pubescent. Leaves alternate, oblong-lanceolate. Flowers yellow in terminal panicles. Very common at 1,985 m. (B. 949).

URTICACEAE

Lecanthus peduncularis (Wall.) Wedd. (= **L. wightii** Wedd.)

Succulent herb, stem 30 to 60 cm. tall, robust. Leaves opposite, unequal. Receptacle 2-4 cm. in diam. ; stalks 22 to 30 cm. long. Common in moist places at 1,068 m. (B. 974).

Pouzolzia viminea Wedd.

An erect shrub with leaves alternate, toothed. Flowers in small dense clusters. Male perianth 4-partite. Rare at 1,832 m. (B. 1042).

ULMACEAE

Trema politoria Planch.

Small tree with leaves alternate, hard and very rough. Flowers unisexual in small axillary cymes. Fruit a globose berry. Occasional at 916 m. (B. 936).

BETULACEAE

Alnus nepalensis D. Don

Tree with leaves elliptic-lanceolate. Female flowers in axillary racemes or 4-8. Bracts of the fruiting spike forming a woody cone. Abundant as a secondary growth on old cultivation terraces at 1,832 m. (B. 1040).

ORCHIDACEAE

Anthogonium gracile Lindl.

Terrestrial. Pseudobulbs about 2.5 cm. in diam. Scape equalling the leaves. Bracts small ; flowers rose-pink ; limb of lip spotted deep red. Occasional at 1,525 m. (B. 944).

Habenaria plantaginea Lindl.

Terrestrial. Scapigerous spike 5-7.5 cm. Flowers pale white ; lip flabelliform, 3-lobed ; spur as long as the ovary. Rare at 916 m. (B. 926).

*__H. urceolata__ C. B. Clarke

Terrestrial with only one leaf. Leaf elliptic-lanceolate. Raceme 5-7 cm. long and curved. Flowers white, lip recurved, spur inflated. Rare at 3,665 m. (B. 1050).

Herminium angustifolium Benth.

Terrestrial. Root of two ovoid tubers. Flowering stem about ½ m. erect, leafy. Flowers small, greenish, crowded. Rare at 1,068 m. (B. 981).

†**H. gramineum** Lindl.

Terrestrial. Plants small—5-15 cm. tall. Spike lax-flowered ; flowers pink. Occasional in open grassy places at 1,985 m. (B. 959).

Satyrium nepalense D. Don

Terrestrial. Roots tuberous. Flowering stem about ½m. with usually two leaves near the base. Flowers small, pink, fragrant ; spurs 2, as long as the ovary. Abundant at 1,985 m. (B. 967).

Spiranthes australis Lindl.

Terrestrial. Roots tuberous. Flowering stem 15-45 cm. tall. Leaves linear-lanceolate, sheathing. Flowers very small, pink, crowded in a spiral ; lip oblong, base saccate. Abundant in open grassy slopes at 1,985 m. (B. 960).

DIOSCOREACEAE

Dioscorea sativa Linn.

Stem slender, purple. Leaves alternate, also opposite, variable in size, deeply cordate. Male spikes almost capillary, flowers crowded. Female spike pendulous. Abundant at 916 m. (B. 933). Probably it is an escape.

LILIACEAE

Allium wallichii Kunth

Bulbs small and clustered. Leaves lanceolate. Scape robust, 3-angled. Flowers purple. Common under shade at 2,440 m. (B. 1027).

Paris polyphylla Sm.

Glabrous herb with thick creeping rootstock. Leaves arranged in a whorl at the summit of the stem. Flower solitary, outer perianth green, leaf-like, inner yellowish green. Capsule globose, seeds scarlet. (No number).

Evolution: the Taxonomer's Approach

BY

R. B. SEYMOUR SEWELL

PART II

[*Continued from Vol.* **55** (1) : 36]

THE FUNCTION OF THE GENE IN EVOLUTION

The Mendelists of the present day, or at least the majority of them, appear to assume that the gene is the sole *cause* of variation. As Simpson has pointed out 'you can establish any rule you like if you start with the rule and then interpret the evidence accordingly'. Wilmott[1] (1950, p. 45) in his lecture on 'Systematic Botany from Linnaeus to Darwin', given at the Linnean Society, remarks: 'I would remind you that we still have no understanding whatever of the nature of the control by which one seed becomes a Poppy and another an *Antirrhinum*. And we discuss the changes in this control system of which we know nothing, calling them mutations and saying that they are caused by changes in certain knots in chromosomes—though in Heaven's name HOW ! !' In spite of the great mass of research work that has been carried out by the Mutationists (and at one time in Cambridge one was not considered to be a zoologist unless one was carrying out experiments on the crossing of various varieties of rabbits, chickens, mice, or insects) all that they have succeeded in doing is discovering the mechanism by which certain relatively small characters could be transmitted from parent to offspring; but in no instance that I know of did they show that the genes could produce any fundamental change in an organism. What they did show very conclusively was that all their experiments on *Drosophila*, for instance, can produce only further examples of *Drosophila*, which vary in small and relatively unimportant characters, such as pink eye, clubbed hairs, curled wingtip, etc., many of which changes are either lethal or would be such a handicap in the struggle for existence that the end result would be lethal.

As early as 1901 Adami[2], whose work seems to have been ignored by subsequent workers, remarks that 'the curriculum of the past, as of the present, lays too little stress upon the value of a broad biological training as an aid in preparing us to discuss those special biological problems which constitute medical study . . . As a consequence the medical world in general has to depend on the biologists proper—upon the zoologists and botanists—for its views upon heredity . . . . The facts which they have elicited have been of the greatest value. Without these facts we would be nowhere, but the contending theories elaborated by them (perhaps I should be last to make any such criticism) have been fearful and wonderful, have started from morphological rather than physiological conceptions . . . While they have appeared to collate and harmonise the facts known at a given moment, new facts have caused them to need modification'. This is particularly true of the Mendelian Theory. At its first inception, that all morphological changes in an organism were due to a change in a gene in the nucleus, one gene controlling one character, the theory was most attractive ; but as our knowledge increased it became necessary to change this conception and it has now been postulated that in order to modify a single character and render the modification hereditary it is necessary to invoke the action of a number of genes and further to assume that a mutating gene may produce effects in several different organs of the body and finally that the effect of a gene may be modified by the action of other genes.

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[1] Wilmott, A. J., 1950. Lectures on the Development of Taxonomy. The Linnean Society of London, London.

[2] Adami, J. G., 1901. On Theories of Inheritance with special reference to the Inheritance of Acquired Characters in Man. *New York Medical Journal*, June 1.

Theoretically, the simplest case of the action of a gene is stated to be exhibited by the agglutination action of the anti-bodies produced in a rabbit by the injection of human blood corpuscles. According to Haldane[1] (1954, p. 19) the agglutinogens are determined by two allelomorphic genes L^M and L^N and he states that 'no treatment has ever led to the appearance or disappearance of either of these substances. They appear to depend wholly on nature and not on nurture. No nurtural difference will as yet abolish either of them without killing the person concerned . . . We can say with great confidence that only one gene is concerned'. He further states that 'no fowl has corpuscular antigens not found on the corpuscles of one of its parents', and yet a little later he also states that 'Irwin (1947) found that hybrids between several species of dove and pigeon had corpuscular antigens which were not present in either parental species along with all the antigens of both parents. Of course the genes were in a very abnormal environment. This observation is a conclusive disproof of the hypothesis that a particular type of gene always makes a particular antigen and that no antigens are made otherwise'.

Sinnott and Dunn[2] (1935, p. 44) claim that 'genes cannot act alone in development. This conclusion is now embodied in the familiar concept of

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[1] Haldane, J. B. S., 1954. THE BIOCHEMISTRY OF GENETICS, George Allen and Unwin, London.

[2] Sinnott, E. W., and Dunn, L. C., 1935. The effect of genes on the development of size and form. *Biological Reviews* Vol. 10, No. 2.

Genic Balance, which assumes that the final characters are the results of interaction among all the genes' and they add that 'this idea clearly is the opposite of that which obtained during the period when genetics consisted chiefly of Mendelian analysis, for then segregation in transmission so impressed geneticists that they tended to carry this idea of the separateness and independence of genes over into development, neglecting the obvious fact that after the organism had been dissolved into such mosaic it must somehow be put together into an integrated whole.'

Huxley[1] (1942, p. 60) has stated that 'genes may have their expression altered by modifiers so as entirely to change their selective value as a result of a change in the internal environment of the cell and these modifiers are supposed to be themselves genes'.

Waddington[2] (1940, p. 85) in order to account for the production of warped or bent bristles in *Drosophila* postulates the following mechanism : 'The first group of genes tends to shunt development into some particular path either towards or away from bristle formation ; the second group affects the quantity of material which is shunted ; while the genes of the third group are part of the system which defines the bristle development path'. So we are now asked to believe that 'big genes have little genes upon their backs to bite 'em, and these again have lesser genes and so *ad infinitum.*'

The final modification in the theory appears to be that the gene may be affected by change in its environment. Not only does a gene by no means always produce the same result, but it seems that its effect can be modified and changed by external conditions. Fisher[3] (1935, p. 73) wrote that 'a large number of observations showed that the effects of Mendelian factors can be largely modified by other heritable factors' . . . (though so far as I understand the belief of the Mendelists, the only heritable factors are the genes themselves). 'Another way of putting this is, that what we call the effect of a mutation should be regarded as the reaction of the organism as a whole to that particular gene-substitution, a reaction which naturally depends as much on the nature of the organism as on that of the substitution concerned. Another way of putting it is that the effects of a gene depend on the internal environment which the organism provides and in which it exerts its developmental effects. In any case it is abundantly proved that the same gene-substitution produces very different effects in different organisms, and that the effect of a Mendelian factor has frequently been much modified by intentional or unintentional selection'.

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[1] Huxley, J. S., 1942. EVOLUTION. THE MODERN SYNTHESIS. George Allen and Unwin.

[2] Waddington, C. H., 1940. ORGANISERS AND GENES. Camb. University Press.

[3] Fisher, R. A., 1935. Some results of an experiment on dominance in poultry, with special reference to polydactyly. *Proc. Linn. Soc. London* 147th Session.

The Soviet School, according to Haldane (loc. cit., 1954, p. 105) appear to think that mutation is often adaptive . . . 'The evidence seems to be against the view that such adaptive changes are at all common. This may be simply because genes do not generally play a very direct part in metabolic processes, and we do not know how to influence them'. Because we do not know how to influence the gene, it does not by any means follow that a change in the chemical composition of the external surroundings, especially if this is of long duration, may not finally induce a corresponding change in the chemical character of the gene, or perhaps it would be more accurate to say of the enzyme which the gene represents.

Haldane (1954, p. 117) has pointed out that 'the nucleus, which is the part of the cell most shielded from the environment, contains those biochemical 'mechanisms' in which change is least needed in response to environmental changes, and this fact gives the cell a stability in the face of external changes which it might otherwise lack' ; and (loc. cit., p. 111) he remarks: 'To what extent genes are altered as a result of changed metabolic processes is a question of fact and not of principle. My own opinion is that they are surprisingly stable.'

On the other hand, Dr A. E. Mourant, President of the Section H, Anthropology, at the Meeting of the British Association for the Advancement of Science in Sheffield, (The Advancement of Science Vol. 13, No. 50, 1956) remarked that 'We are on the one hand, using gene frequencies as indices of relationship between populations and, on the other, seeing them modified by the environment. Some genes, including probably most of the blood-group genes, are influenced only very slowly by the environment and are stable indications of relationship. Others are more sensitive to the environment and so while easier to investigate physiologically and medically are less reliable as evidence of distinct ancestry . . . It is likely that every gene is ultimately subject to environmental control'. This conclusion would seem to be the exact opposite of that reached by Haldane, as quoted above.

In certain instances it seems that a change in the external environment may at once cause a corresponding change in the form and structure of an organism; Hile[1] (1936) has pointed out that 'allometric growth together with its alteration owing to seasonal differences in the food-supply, etc., may induce form differences as great as some of those found in named subspecies.'

But in other instances it may take an appreciable time and perhaps even a series of generations before the effect becomes obvious. This latter process would thus resemble what Haldane terms 'training' and which is now recognised as occurring in bacteria and protozoa. Haldane (1954, p. 89) remarks, regarding bacteria, that 'to my mind it has been demonstrated quite conclusively that training occurs in some cases, that is to say that an organism acquires a bio-chemical aptitude which it did not formerly possess or that if it possessed it the rate at which the process is performed is increased several thousand times'. He points out that, even if this character were continued for several generations the geneticist would not consider that he was dealing specifically with a genetical phenomenon, since the modification might be handed on by the persistence in the offspring of the enzyme that produced the change but its amount being on the average halved at each generation and he points out that the important question for a geneticist is not 'Can a cell acquire a new function and how long does it take to "train" it ?' but 'How quickly is the training lost or "forgotten" ' or 'How quickly does the reversion occur ?' What would seem to be far more important for the taxonomist is the question 'Does the change persist ?'

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[1] Hile, R., 1936. Summary of Investigations on the Morphometry of the Cisco, *Leucichthys artedi*, etc. *Pap. Mich. Acad. Sci.* 21 : 619.

Bawden[1] (1956) states that 'many examples could be quoted of bacteria that acquired new properties such as the ability to produce capsules and resistance to bacteriophages or antibodies, when they are grown in an appropriate medium together with other bacteria that possess these properties. There seems no *a priori* reason for such a phenomenon to be unique to bacteria and comparable exchanges of cellular constituents might also be expected in other systems of mixed cells when the cell walls are incompletely developed'.

Thus, while agreeing with Huxley (loc. cit., p. 178, footnote) that we can be certain that some, perhaps the majority, of described forms may have a genic basis, it seems possible if we go no further that the differences may at least in certain instances be due primarily to a change in the chemical composition of the protoplasm of the cell itself, i.e. the cytoplasm, and not vice versa. As Graham Cannon[2] (1956, p. 15) has pointed out 'a complicated protozoan with half a dozen different types of cilia dividing asexually into two perfectly formed and identical individuals, manufactures these elaborate structures and this can only be by virtue of its chemical constitution. How it comes about we do not know, but there is the fact that specific protoplasm in these protozoa produces specific structures'. Moreover since these specific structures are situated in perfectly definite parts of the organism the chemical composition of these various parts must be specifically different.

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[1] Bawden, F. C., 1956, in the Discussion following Koprowski, H., Gail Theis, and Lowe R., on Immunological tolerance in Tumour Studies. *Proc. Roy. Soc., London,* Vol. 146. p. 37.

[2] Cannon, H. Graham, 1956. An Essay on Evolution and Modern Genetics. *Journ. Linn. Soc. London,* Zoology, Vol. 43.

BIOCHEMISTRY AND THE MENDELIAN THEORY

At about the same time as the discovery of the Mendelian theory, some scientists began to study the possibility that the inheritance of characters from parent to offspring might be due to a chemical change in the body.

Weismann[1] (1904, Vol. 2, p. 111) argued that if there were any inheritance of functional modifications in the body 'something, and that something material must be modified in the germ-plasm, if the vigorous use of a group of muscles, or of a gland, or of a nerve cell, is to be communicated to the germ, and not to the whole germ plasm, but only to so much of it as is necessary to cause variation in the corresponding group of cells in the child . . . One might, with Herbert Spencer, conceive of the germ-plasm as consisting of homogeneous units which vary in the development in accordance with the diverse regularly alternating influences to which it is exposed from step to step and that therefore in each of these units of very complex structure only a single molecule, or perhaps only a single atom, would need to vary in order that in the course of development, the resulting cell-group should appear in the rudiment in somewhat altered strength'. Herbert Spencer seems to have got nearer to the present line of thought than those Mendelists who regard a gene as a particle rather than as a chemical molecule. Weismann, however, dismissed the view that a chemical change could be the explanation of the different effects of a gene : he remarks, 'I do not believe that a chemical molecule, still less an atom, is sufficient for this . . . It follows that the "unit" is made up of numerous "molecules or atoms" of which each, by dint of changes it has undergone, causes particular parts of the body to vary in a definite manner.' On the other hand he writes of these 'determinants' as being 'vital units of such a kind that they communicate to the cells and lineage of cells into whose bodies they migrate from within the nucleus, a definite vital power, that is an organisation which regulates the size, form, number of divisions, and so on, of these cells'; he considers that 'always however, they act in co-operation with the cell body into which they have penetrated' but he adds 'I should object to the assumption that the "determinants" of the germ are ready-made histological substances'. Since he rejects both the chemical and the histological character of his determinants it seems extremely difficult, if not impossible, to decide as to what he actually thought these determinants were; he did, however, envisage that external influences might modify the effect of the determinants and that they would give rise under normal external influences to normal parts, while under unusual influences, if these were not such as to prohibit development altogether, they may give rise to an abnormally formed part. He (Vol. I, p. 349) refers to the work of Nageli and his use of the term 'idioplasm' to describe the hereditary substance of a cell, and he points out that he (Nageli) sought it in the cell-substance not in the nucleus and had a different theoretical conception of its mode of action. 'It was he however who conceived and established the idioplasm as the bearer of the primary constituents or *Anlagensubstanz*, determining the whole structure of the organism in contrast to the general nutritive protoplasm'.

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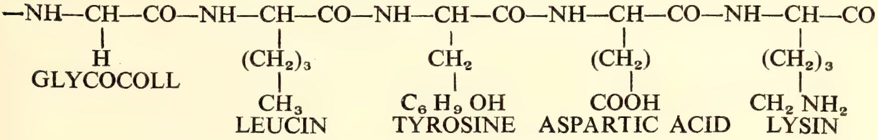
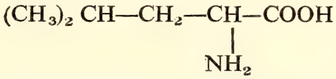
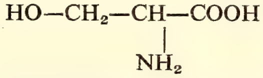
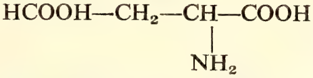
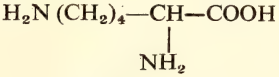
[1] Weismann, A., 1904. THE EVOLUTION THEORY. Translated by J. Arthur Thomson and Margaret Thomson. Edward Arnold, London.

Adami was primarily a pathologist and much of his argument is based on a study of bacteria. He calls attention to the fact that chemists had shown that in certain relatively simple chemical compounds more than one form of construction of the molecule is known to exist and that this difference confers certain different properties on the molecule : as an example he cites malic acid, which is known to exist in laevogyrous and dextrogyrous forms, as well as an inactive form, showing different properties both as regards their effect on polarised light and in their physiology ; and he argues that, if these differences are due to an alteration of the position of certain atoms in the molecule, a similar difference may be caused in the much more complex protoplasmic chemical by an alteration in the character or in the position in the molecule of a side chain. This he terms his 'Side-Chain Theory', and in a later paper[1] gives the following illustration of the composition of the proteid molecule or a part of it :



$$-\mathrm{NH}-\underset{\substack{|\\ \mathrm{H}\\ \text{GLYCOCOLL}}}{\mathrm{CH}}-\mathrm{CO}-\mathrm{NH}-\underset{\substack{|\\ (\mathrm{CH_2})_3\\ |\\ \mathrm{CH_3}\\ \text{LEUCIN}}}{\mathrm{CH}}-\mathrm{CO}-\mathrm{NH}-\underset{\substack{|\\ \mathrm{CH_2}\\ |\\ \mathrm{C_6\,H_9\,OH}\\ \text{TYROSINE}}}{\mathrm{CH}}-\mathrm{CO}-\mathrm{NH}-\underset{\substack{|\\ (\mathrm{CH_2})\\ |\\ \mathrm{COOH}\\ \text{ASPARTIC ACID}}}{\mathrm{CH}}-\mathrm{CO}-\mathrm{NH}-\underset{\substack{|\\ (\mathrm{CH_2})_3\\ |\\ \mathrm{CH_2\,NH_2}\\ \text{LYSIN}}}{\mathrm{CH}}-\mathrm{CO}$$

According to Haldane (1954, p. 137) the correct formulae for the above molecules are as follows

Glycine	$\mathrm{NH_2-CH_2-COOH}$
Leucine	 $\mathrm{(CH_3)_2\,CH-CH_2-\underset{\substack{|\\ NH_2}}{CH}-COOH}$
Tyrosine	 $\mathrm{HO-CH_2-\underset{\substack{|\\ NH_2}}{CH}-COOH}$
Aspartic Acid	 $\mathrm{HCOOH-CH_2-\underset{\substack{|\\ NH_2}}{CH}-COOH}$
Lysine	 $\mathrm{H_2N\,(CH_2)_4-\underset{\substack{|\\ NH_2}}{CH}-COOH}$

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[1] Adami, J. G., 1905 and 1909. A Lecture on Life. Delivered before the McGill Medical Students' Society in 1905 and redelivered with additions before the Ottawa Valley McGill Graduates' Association in 1909. MEDICAL CONTRIBUTIONS TO THE STUDY OF EVOLUTION. Duckworth and Co. London, 1918.

In his discussion on the Side Chain Theory Adami (1918, p. 146) remarks that 'if the circumstances affecting the filial idioplasm vary from those affecting the parental, then these more unstable and loosely connected side-chains will be the first to be influenced. The very act of assimilation (the surrounding medium varying in its composition) may lead to the substitution of other side-chains, to slight variation in the composition of the idioplasm. And the cell or individual developed or controlled by the idioplasm will therefore vary from the parent form, while the products of division of the second generation, containing as they do this modified idioplasm, will exhibit the structural modification'. Throughout Adami uses the term idioplasm to refer to the chromosomes, but the same argument will apply equally well to the cytoplasm and it is the cytoplasm that is the agency by which any abnormal constituents of the external environment must be imbibed and assimilated for it is only through the cytoplasm that any substance can reach the nucleoplasm of the chromosomes.

Adami, writing in 1901, stated that 'to the worker in bacteriology the hesitancy on the part of biologists to accept environment as a most important factor in originating variations is almost incomprehensible . . . The argument that phenomena observed in unicellular organisms cannot be applied to multicellular oganisms is, to say the least, a severely strained argument. The extent to which environment acts as a factor may, it is true, be diminished in the latter, but surely it cannot be regarded as eliminated and rendered negligible'. In 1912 (loc. cit., p. 28) he claims that the bacteria are extraordinarily conservative in their form and that, given the same environment, they will produce exactly similar progeny, while on the other hand they are very susceptible to alteration in their environment and will exhibit considerable alteration in their form. 'Nothing', he states, 'in fact, is more easy to demonstrate than this capacity on the part of bacteria as a class to vary according to alterations in environment' and, moreover, that 'we can so arrange our experiment as to obtain, not evidence of variation in many directions, the favourable variant alone surviving, but evidence that organisms placed in a given environment all vary in one identical direction with clock-work regularity'. This is the exact opposite of the claim made by Simpson (*vide supra*, p. 25) that organisms do not respond in a uniform way to a change in environment, unless he intended to imply that different organisms experiencing identical changes in their environment do not exhibit identical modifications : but why should they and why should we expect them to do so? Different organisms are composed of differing protoplasm and after a small change in the chemical composition will still remain different, except in such relatively rare instances in which a change in the protoplasm of one organism causes its chemical composition to approximate to that of some other organism, in which case we might well expect to find evidence of convergence. This hesitation in accepting the results of the study of inheritance in bacteria as throwing any light on what goes on in multi-cellular organisms still persists and Haldane[1] (1954, p. 52) remarks that 'there is no reason to expect *a priori* that the general principles of genetics should hold good for bacteria. If some of them do so, that is very statisfactory, but it seems equally unwise to argue, except in the most tentative way, from bacterial mutations to mutations in other organisms, or from non-Mendelian behaviour in bacteria against Mendelian behaviour in other organisms'. This warning seems to me to be a sound one only so long as we adopt the view of the Mendelists, who insist that the whole process of evolution is due solely to changes in the genes, and ignore the possibility that the cytoplasm may be responsible for the inheritance of some at least of the characters of the general body-form.

DOES THE CYTOPLASM PLAY ANY PART IN EVOLUTION

It would appear that there was and still is a considerable amount of evidence that Adami was fully justified in his criticism of the Mendelian Theory. At the present day the view that the genes of the chromosomes of the zygote may be the agents whereby modifications can be made in small structural features but that the general shape of the body and its more obvious characters may be inherent in the chemical composition of the cytoplasm seems to be gaining ground. Huxley (1942, p. 60), as I have already mentioned, has remarked that genes may have their expression altered by modifiers so as entirely to change their selective value 'as a result of changes in the internal environment and this internal environment must presumably depend on the chemical composition of the protoplasm of the cell that contains the nucleus, i.e. the cytoplasm' and a little later he claims that 'a character-difference may be said to be inherited in Mendelian fashion, while a character cannot: but even so the differential effect of a particular gene on the character need not by any means be always the same. It may alter according to differences in the environment and also according to differences in the remainder of the gene-complex'. If this statement really means what it says, then it raises the question: How and by what means are characters inherited? And, is there any mechanism by which characters are inherited other than by the action of the genes?

At the present time there seems to be growing a gradual recognition that the cytoplasm must play at least some part in the inheritance of bodily characters and that there is considerable justification for the view put forward by Russell[1] (1930) that the genes are concerned solely with differences in certain minor characters, and have nothing whatever to do with cellular differentiation, which in fact affects solely the cytoplasm. He appears to sum up his view of the function of the nucleus in the following words : 'If the nucleus represents essentially the conservative element in the cell, as the bearer of certain fundamental metabolic rhythms and the producer of certain essential enzymes and hormones, the fact that its continuing identity is accurately conserved by its exact division in mitosis indicates one means by which precise repetition of type is favoured' (loc. cit. p. 290).

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[1] Haldane, J. B. S., 1954. THE BIOCHEMISTRY OF GENETICS, George Allen and Unwin, London.

Haldane[2] (1954, p. 11) states that 'we sometimes, particularly in plants, find a character which is cytoplasmically determined, but such characters are not very common' and (loc. cit., p. 87) 'quite recently Mitchell and Mitchell (1952) have obtained the first cytoplasmically determined mutant in *Neurospora crassa.* This is "poky", a slow grower for reasons at present unknown', and again (loc. cit., p. 88) 'a number of self-propagating cytoplasmic properties are known in higher plants. Some are transmitted purely maternally'. Waddington[3] (1939, p. 137) remarks that 'the simplest hypothesis to account for the general control of development might seem to be that the genes were gradually sorted out by unequal division of the zygote nucleus, so that each part of the embryo received a different collection of genes, which would then determine the particular way in which that part would develop. Actually this hypothesis is not so simple as it seems ; it would be difficult to imagine a mechanism for the differential division without assuming that the kind of genes which went into a particular nucleus were determined by the kind of cytoplasm surrounding the nucleus'. . . . He goes on to remark that 'there is evidence from many different groups of animals that all the first cleavage nuclei, at any rate, are equivalent and can be substituted for one another' and he states that the only example of differential division in the early stages of development is in *Ascaris,* where it is probably caused by, and not the cause of, cytoplasmic differences. But is this actually the case ? In a number of instances the two cells of the 1st division of the zygote can be separated and each will develop into a complete normal individual but in some cases and possibly in many the two individuals thus formed, as in true twins, are not similar but are looking-glass reflections of each other—one has undergone the process known as *situs inversus.* Waddington (loc. cit., p. 239) goes on to suggest that 'during a certain period a process takes place which fixes the future course of development of the various regions ; this process is 'determination'. If this be the case, then surely we must admit that in those cases in which the one individual is the looking-glass reflection of the other and invariably in those animals that are bilaterally symmetrical we must have two determinants one for each of the paired organs, for we do not possess merely two arms or two legs or two eyes but a right and a left one and these are looking-glass reflections of each other ; one determinant must be dextrorotatory and the other laevorotatory as Adami suggested (*vide supra*, p. 275). In some Gastropoda, e.g. *Limnaea*, coiling is stated to be caused by two genes, the one dextral and the other sinistral, the dextral being dominant, 'but the direction in which a snail coils is determined not by the genes it contains but those its mother contained' and the way in which any given snail coils is determined by the cytoplasm of the egg from which it developed and this cytoplasm is said to be dependent on the genetic constitution of the mother, right-handedness being dominant.

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[1] Russell, E. S., 1930. THE INTERPRETATION OF DEVELOPMENT AND HEREDITY. Clarendon Press, Oxford.

[2] Haldane, J. B. S., 1954. THE BIOCHEMISTRY OF GENETICS. George Allen and Unwin, London,

[3] Waddington, C. H., 1939. AN INTRODUCTION TO MODERN GENETICS.

Waddington (loc. cit., p. 192) claims that 'morphological patterns, such as we find in living organisms, are arrangements of different substances or tissues in definite positions in space. . . . However far we can analyse the development of a pattern we shall therefore be left with an initial heterogeneity to account for' ; and he suggests that among bases for such heterogeneity are 'local differences in the cytoplasm as the immediate source of the whole pattern of the animal. The formation of the pattern within the organisation centre seems to be connected with the localisation of the organiser within the egg and the process . . . is mainly cytoplasmic or at least independent of the zygote nucleus'. Medawar[1] (1947) sums up the various theories that have been put forward in the following words : 'Since the majority of the objects called 'cells' . . . have already been credited with the possession of nuclear genes, many geneticists and embryologists are rightly disinclined to admit the existence of other self-reproducing particles in the cell. The evidence of cellular transformation nevertheless demands it. Work on the transformation of yeast cells has made it clear that 'cells with identical genomes need not possess identical enzymatic constitutions (Spiegelman, 1945). Moreover, such attempts as have been made to determine whether or not the cells of the same adult individual have or have not the same complement of nuclear genes shows quite clearly that they have'. In his summary 7, he says that 'the inherited character differences between cells are particulate and combinatorial in nature, and there is ground for supposing that they are mediated by *cytoplasmic* (the italics are mine, R.B.S.S.) entities that behave as discrete self-reproducing particles'. Dalcq (1956)[2] writes : ' Embryologists . . . observe that a definite and constant spatial organisation has so far not been detected in the germinal vesicle, while it can often be observed in the cytoplasm . . . In my opinion, hereditary patterns of form are not satisfactorily explained by the sole continuity of gene units. In their transmission they are never wholly independent of cytoplasm,' and a little later he writes : ' I personally feel justified in believing that the fundamental and probably primary state of germinal organization in Metazoa is the co-existence of an internal polarisation (a simple gradient) of the cytoplasm '. But when he states that ' The environment only affords the general basic conditions for life, moisture, oxygen, a convenient equilibrium of ions, a favourable level of osmotic pressure ', etc., he fails to mention other forces that lie completely outside the developing egg, such as gravitation, for how otherwise can one account for the condition found in the egg-capsules of the common cockroach, *Periplaneta australis.* As I[1] wrote (Sewell, 1931, p. 7) : 'In this animal the female lays a capsule containing 16 eggs arranged in two rows and as development proceeds these eggs all develop in exactly the same way ; the embryo is always situated from the very first with the head towards the crenated ridge that runs along the top of the capsule and the ventral aspect of the larva is turned inwards towards that of the corresponding larva on the opposite side of the capsule. It seems clear that this fixed position is due to forces acting on the egg, for one can hardly suppose that the mother cockroach invariably places all the separate eggs in exactly the right position '. A similar orientation is found to be present in the very young aggregated zooids of pelagic Tunicates such as *Iasis zonaria* (Pallas) and *Pegea confoederata* (Forskal), which are situated along the stolon in pairs with their ventral surfaces closely approximated. (*vide* Sewell[2], 1953, p. 23 and Text fig. 6, A and B).

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[1] Medawar, P. B., 1947. Cellular inheritance and transformation. *Biol. Reviews* Vol. 22, No. 4.

[2] Dalcq, Albert, M., 1956. Form and Modern Embryology: in ASPECTS OF FORM. Edited by Lancelot Law White. Published by Lund Humphries.

HEREDITY AND THE INFLUENCE OF BIOCHEMISTRY

The present trend of thought seems to be that, so far as the chemical composition of the body is concerned, it is the cytoplasm that is the active agent. Haurowitz[3] (1952) in a review of the mechanism of the immunological response, points out that each animal synthesises its own particular protein and that the chemical composition of the proteid is a specific character ; and he [loc. cit. (1952), p. 269] envisages the protein molecule as a chain, not a ring as Adami figured it, and its species-specificity as due to the number and sequence of amino-acids in the two-dimensional peptide film, and he suggests that the haemoglobins of different species have different terminal amino-acids at the end of the proteid chain. Haldane and Priestley[1] (1935) even went so far as to suggest that the composition of the haemoglobin of the blood might even be individualistic, but Haldane (J.B.S.) thinks that this is going too far. For our present purpose it is sufficient to assume that the chemical composition of an animal is a true specific character. As Haurowitz points out, ' Human beings will always form a human proteid, whether they eat meat, cheese, or plant proteid ', though the composition of this proteid can be modified and altered by the injection of an antigen and this is followed by the formation of a specific antibody that is a modified protein. Clearly then the cytoplasm of the cell must be a synthesising agent, for after digesting the various and varied food-stuffs into their ingredients, such as peptones, etc., it must then build these up again into its own specific proteid.

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[1] Sewell, R. B. S., 1931. Experimental Modification of Bodily Structure, Presidential Address, Indian Science Congress, Nagpur.

[2] Sewell, R. B. S., 1953. The Pelagic Tunicata, *Sci. Rep. John Murray Expedition.* Vol. 10, No. 1.

[3] Haurowitz, P., 1952. The Mechanism of immunological response. *Biological Reviews,* Vol. 27, No. 3.

Haurowitz (loc. cit., p. 269) points out that ' when we try to explain the formation of the species-specific peptide chain we depend mostly on speculation. Obviously the formation of a peptide chain from amino-acids or from other peptides requires the presence of enzymes which catalyse the formation of peptide bonds or transpeptidation. However the specificity of the peptide is formed, the specific arrangement of its amino-acids cannot be attributed to enzyme action . . . We cannot imagine a catalyst which catalyses different reactions at different times and " spins " a pattern of amino-acids. The factor responsible for the formation of species-specific peptide chains in the first phase of protein synthesis is most probably a species-specific template '. Here we seem to come very close to the side-chain theory put forward by Adami in 1917 in his Croonian Lecture (Adami[2] 1918, pp. 74 *et seq*). Pantin[3] (1932, p. 706) has pointed out that ' the living organism comprises material structures of different orders of complexity varying from tissues and cells to particular kinds of molecules which compose them. A variety of active processes takes place in these structures and their existence depends on them. . . Conversely, the structures themselves have been brought into existence by such processes. . . These structures, processes, and states endow an organism with certain properties, so that when subjected to a particular experimental treatment it reacts in certain definite ways '. He goes on to point out that the morphological features are composed of physiological features and these in turn are composed of chemical molecules and that it is in the structure of the molecule that specific differentiation first becomes apparent, and it would seem that a change in the chemical structure of the molecule can only be brought about by a change in a definite unit within the molecule. Thus, as he points out (loc. cit., p. 710), ' it seems that adaptation of these structures can only be evolved by the natural selection of abrupt variations—a condition precisely satisfied by Mendelian mutation '. If now there is a possibility that the shape of an organism is a result of a specific composition of the cytoplasm and that the gene, as postulated by Haldane (1954, p. 111) 'as a chemically definable object existing in a given cell at a given moment, is a product of metabolism like any other chemical constituent ', then it would seem to follow that the gene, which is a chemical molecule, possibly a nucleo-proteid, becomes merely the ' outward and visible sign of an inward and chemical difference ' and it becomes clear that, as Haldane (loc. cit., p. 103) remarks, ' mutagenesis is a biochemical rather than a biophysical process ' and (loc. cit., p. 82) he has gone so far as to admit that ' clearly there are biochemical differences between individuals of a species and some of these are genetically determined '.

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[1] Haldane, J. S., and Priestley, J. G., 1935. RESPIRATION. Oxford.

[2] Adami, J. G., 1918. MEDICAL CONTRIBUTIONS TO THE STUDY OF EVOLUTION. Duckworth and Co., London.

[3] Pantin, C. F. A., 1932. Physiological Adaptation. *Journ. Linn. Soc. London*, Zoology, Vol. 38.

At the present time much attention is being paid to the functions of ribonucleic acid and desoxyribonucleic acid in the cytoplasm and in the chromosomes of the nucleus of a cell; and an anonymous author[1] (1955) in a study of nucleic acid and disease, states that 'the principal types of nucleic acid are found in living cells, desoxyribonucleic (DNA) restricted to the chromosomes of the nucleus and ribonucleic acid (RNA) present in the nucleolus and the cytoplasm '. He goes on to state that ' up to quite recently it has been assumed that the DNA of the chromosomes was the only genetic substance in the cell. There are now indications that RNA may also have genetic activity. Firstly, this is implied by the similarity of structure of the two nucleic acids. Secondly, the eggs of the echinoderms, *Asterias forbesii* and *Arbacia punctulata*, have been found to contain no DNA as determined by the Feulgen staining and C-labelled thymine studies. Thirdly, some organisms show cytoplasm inheritance by plasmogenesis, and, fourthly, the smallest (less than 42 m· diameter) viruses have so far been shown only to contain RNA '. Haldane (1954, p. 98) admits that ' it is at least plausible that the genes are desoxyribonucleoproteins, the self-reproducing cytoplasmic units being more usually ribonucleoproteins '.

I have already (*vide supra*, p. 30) quoted Lowndes and Fisher, both of whom have expressed the view that any change in the environment must be to the disadvantage of the organism that is adapted to live in it : if this view be correct, as I think is probable so far as some changes are concerned, and the organism is incapable of adaptation, then it would be true to say that, if the genes, either individually or collectively, are the sole agents by which changes are brought about in the morphology and physiology of an organism, too high a degree of stability would be a grave disadvantage to the organism. Huxley (1942, p. 122) accepts the view that the nature of an organism thus influences the mode of its evolution, and he points out (loc. cit. p. 131 *et seq.*.) that ' the genetic system must have had a long evolution behind it before it reached what we may call the meiotic stage, with its elaborate mechanism. Two prior main stages may be distinguished, the pre-mitotic and the mitotic, and organisms still survive which are equipped with genetic systems of these earlier patterns '. He goes on to state that ' we must, in fact, expect that the processes of variation, heredity and evolution in bacteria are quite different from the corresponding processes in multicellular organisms . . . Purely mitotic organisms may have enjoyed a more elaborate genetic constitution, with its parts more accurately adjusted, than the pre-mitotic ones . . . . They are compelled to forgo most of the advantages of their genetic complexity for lack of the meiotic process which permits the recombination of the genetic units '. It seems to me that Huxley begs the whole question when he supposes that the unicellular organisms, such as the Protozoa and the early multicellular organisms, before sex came into existence, were ' compelled to forgo the advantages of the meiotic sexual process'. As Simpson (1941, p. 19) has pointed out, ' a protozoan, because ancient and relatively simple, is not therefore an imperfect type destined for replacement within its own sphere. Other phyla represent, not advances over the protozoa for life as protozoa live it, but the development of other possibilities, other ways of life and filling of other spheres in the economy of nature'. One of the outstanding trends throughout the whole process of evolution has been the increasing complexity of the organism, a process that necessitated a change in the whole physiology, definite physiological processes being connected with definite organs within the body of the organism and it seems probable that at about this phase in evolution there was not a change in but an addition to the method by which the organism adapted itself to its ever changing environment.

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[1] Anonymous, 1955. Nucleic Acids and Disease. *St. Bartholomew's Hospital Journal*. Vol. 59, No. 1, 1955.

Graham Cannon[1] (1956, p. 15), in his admirable review of evolution and modern genetics, put forward the view that ' since the reactions of the earliest living matter can only have been changed in response to a changing environment to maintain equilibrium with that environment, it follows that the first evolution of individuals with definite body form from formless granules of protoplasm must have represented simply one of those changes ', i.e. to adjust themselves both structurally and physiologically to their changing environment, and this property of the protoplasm of the cell must surely still persist, but has been modified in higher animals by the development of a new and different method of control.

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[1] Cannon, H. Graham, 1956. An Essay on Evolution and Modern Genetics. *Jour. Linn. Soc. London,* Zoology, Vol. 43.

At about the same time in the process of evolution from non-cellular to multi-cellular organisation there must have been a great flowering of forms. Simpson (1951, p. 18) has pointed out that ‘ all the phyla are of great antiquity. All date from the Cambrian or Ordovician ’ . . . and ‘ since sometime in the Ordovician, around 400,000,000 years ago, no new type of animal has appeared on earth. It would appear that the fundamental possibilities of animal structure had then all been developed ’. In the early stages it would seem that animal organisms were very susceptible to change in their environment. As I pointed out[1] (1931, pp. 10, 11) ‘ in the very early stages of life on the earth, the animal adapted itself to the environment ’ and ‘ owing to the permeability of the outer wall or ectoderm any changes in the surrounding medium (which in all probability was the sea) were rapidly compensated by similar changes in the animal itself. But as evolution progressed we find that this adaptability was given up and the animal began to react *against* environmental changes’. Attention to this type of evolutionary process was drawn by Wardlaw[2] (1930). This reaction against the environment is seen in the manner in which the organism has steadily evolved means of protecting the zygote from external changes. ‘ In the lowest organism eggs were and are laid in water and possess only a thin and delicate membrane around them, so that they are directly affected by changes in the external surroundings. Exposure to air would cause their drying up and the consequent death of the embryo, while changes in temperature would alter the rate and character of development. Then came the stage when the eggs were surrounded by a thicker covering, chitinous in some cases or with a lime shell in others. Such a shell prevents evaporation, so that the eggs can now be laid on land. . . Finally animals tend to become viviparous and development occurs *in utero* where the embryo is maintained in equable surroundings, completely protected from changes in temperature, salinity or other changes in the external conditions, since those of the parent remain constant ’ (Sewell, 1931, p. 12).

As Haldane has pointed out (1954, p. 117), ‘ The nucleus, which is the part of a cell most shielded from the environment, contains those biochemical “ mechanisms ” in which change is least needed in response to environmental changes, and this fact gives the cell a stability in the face of external changes which it might otherwise lack ’. But there is no proof that the nucleus and still less the chromosomes contain *all* the mechanisms that are needed for adaptive changes in response to environmental changes. Haldane (1954, p. 84) writes : ‘ If the central thesis of this book is correct, all genetically determined variation has a biochemical basis. This basis will only be known when the biochemistry of morphogenesis is understood'. Billingham and Brent[1] (1956, p. 87) remark that ' Nuttall's (1904) early work and more refined studies by Boyden (1943) have shown that the capacity of animals of different species to react immunologically against each others' proteins may be made the basis of a test of their zoological affinities ', and Sir Macfarlane Burnet[2] in his summing up of the discussion on Immunological Tolerance claims that ' At the chemical level the central problem of biology is the replication of organic pattern as typified in the synthesis of functional protein.'

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[1] Sewell, R. B. S., 1931. The Problem of Evolution II. The Trend of Evolution under Natural Conditions. Presidential Address, Asiatic Society of Bengal.

[2] Wardlaw, H. S. H., 1930. Some Aspects of the Adaptation of living Organisms to their Environment. Presidential Address, *Proc. Linn. Soc. N.S. Wales,* Vol. 55, Pt. I, p. viii.

If the gradual development of the body is controlled by the chemical composition of the protoplasm of the cells or of the body fluids, the biochemist should be able to detect differences between the blood or body-fluid of a larval stage and of the corresponding adult.

Russell (loc. cit., 1930, p. 9) clearly believes in the recapitulation theory of development, that ontogeny in the main must follow phylogeny and he claims that ' a complete theory of development would have to take into account also the life cycle as a whole, with its successive phases of youth, maturity and old age, and not limit itself merely to the phenomena of embryonic development'.

Haurowitz (1917) states that there is an important difference between the plasma protein content of the blood of newly-born and of adult animals and he gives the following changes in the horse :

Albumen	α – globulin	β – globulin	γ – globulin	Age
65	32	3	0	1 day
33	14	25	28	8 months
30	11	12	47	10 years

and one may ask whether such ontogenetic changes could throw any light on the phylogenetic origin of a species ? That there must be such differences at different stages of development seems to be indicated clearly by the chemical alteration of the blood during the metamorphosis of Amphibians, regarding which Allen[3] (1938), after considering the changes that take place in the body, states that 'If metamorphosis is controlled by a gene, then the gene has had first to activate the anterior part of the hypophysis to produce a hormone that stimulates the thyroid and then this starts the metamorphosis '. This reminds one of the old nursery rhyme ' The House that Jack built '.

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[1] Billingham, R. E. and Brent, L., 1956. Acquired tolerance of foreign cells in newborn animals. *Proc. Roy. Soc. London*, Vol. 146, Series B., p. 78.

[2] Burnet, Sir M., 1956. Ibid., *Proc. Roy. Soc.* Vol. 146, Concluding remarks.

[3] Allen, B. M., 1938. The Endocrine Control of Amphibian Metamorphosis. *Biol. Reviews.* Vol. 13.

CONCLUSION

Throughout the whole course of evolution there has been a steady urge towards bodily complexity and simultaneously with this has been a drive towards biochemical complexity ; and the full extent of this is only now beginning to be understood, but it seems clear that the ultimate character upon which the final decision as to what is a ' species ' will be based may eventually prove to be bio-chemical. Already this search for a chemical proof of relationship has gone some way and is being utilised in the attempt to trace the past history of races and nations and even to check the possibility or impossibility of the supposed parentage of an infant by the biochemical properties of its and of its parents' blood. But, if we should ever reach this stage, it seems somewhat doubtful whether it will be as conclusive as one might hope, for it has been suggested that there is some evidence to show that the character of the haemoglobin of the blood and, presumably, of the protoplasm of the cells may even be individualistic and not specific, in a manner similar to that found in the finer details of structure. In such circumstances the Taxonomer will be no better off than he is now. Haldane has been reported to have said in an interview with a press-reporter that he is not interested in the problem of why a cat has kittens, but in the problem why a white cat has white kittens. But to the taxonomer and systematist it is all important to know whether a kitten had a cat for its mother and the assurance that the kitten will eventually, barring the accident of death, grow into a cat and itself produce kittens, though one must equally face the fact that if this goes on for a sufficiently long time through successive generations and in different surroundings it will ultimately produce something that is not a member of the species *Felis domesticus* but has gradually changed into a different species to which some future zoologist will give a new name, followed by the letters *sp. nov.*

To sum up, I cannot do better than quote the following passage from Smart[1] (1950, p. 82) : ' What the morpho-systematist must now do is to make himself fully acquainted with all available information about the species that have been intensively studied and correlate the phenomena exhibited by these species with comparable phenomena seen in the populations of organisms that he is investigating. The systematist can then give an opinion as to which segregates in his materials would constitute species, etc., if the population of the organism were submitted to genetical and other laboratory techniques. Curiously enough, when work of really competent morpho-systematists is re-examined in the light of findings of genetics, etc., it is often found to be extraordinarily accurate'.

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[1] Smart, J., 1950. Post-Darwinian Development of Taxonomy (Zoology). Lectures on the Development of Taxonomy. The Linnean Society of London.

Indian Marsileas: their Morphology and Systematics

3. On The Examination of Some Further Collections of *MARSILEA* from South India and Rajasthan

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[*Continued from Vol.* **54**(3) : 567]

(*With* 12 *figures*)

Since the publication of our paper on the examination of some collections of *Marsilea* in India (6) some friends from south India have very kindly sent us their material for examination and identification. We are not only grateful to these botanists but wish to record that our hopes of discovering interesting material from south India have been fully justified. The following collections have now been examined :

Name of Herbarium	No. of sheets examined	No. of spp. present	No. of sheets redetermined
1. Madras Museum, Coimbatore ..	26	2	7
2. Botanical Survey of India, Western Circle, Poona ..	13	1	6
3. Central College, Bangalore ..	25	5	16
4. Jaswant College, Jodhpur ..	5	4	—

The Bangalore and Coimbatore collections have been found to contain material of two foreign species namely *M. brachycarpa* A. Br. originally collected from Pegu, Burma, and described by Bräun in 1863 (2 & 3) and *M. tenuifolia* Engelm. first described by Engelmann ex Kunze (4) from the United States of America in the year 1848. Later Bräun (2, 3) and Baker (1) studied this material further. Figures 1 and 6 representing *M. brachycarpa* and *M. tenuifolia* are drawn from the Bangalore collection and figures 4 and 5 representing *M. brachycarpa* from the Coimbatore collection. The occurrence of these two types in the Indian flora is being reported in a separate communication by the present authors. Not only this, but the collection from the Central College, Bangalore, and the Madras Museum, Coimbatore, contain herbarium sheets having material which in some cases is fairly clearly comparable to the original types of Bräun such as *M. brachypus* and *M. gracilenta* (Nos. 175 and 180). It is very encouraging to note that further fresh collections from the Bangalore-Mysore region as well as the Nilgiris will surely mean collecting types of those rare species of *Marsilea* which were only briefly described by Bräun nearly a century before. It is necessary to point out that the original material of Bräun's species is available only at the Botanischer Garten und Museum, Berlin Dahlem, and its duplicates, as far as we know, are not available anywhere else in the world. We are grateful to Dr. D. Meyer of Berlin for photographs and small quantities of material from the original herbarium sheets for our comparison and study.

Further collections in Rajasthan have yielded very good results. The present examination has confirmed the occurrence of *M. aegyptiaca* in Ajmer. This was doubtful so far ; but recently one of us has actually collected this species from the Anasagar Lake in Ajmer. This makes *M. aegyptiaca* a fairly widespread species in arid Rajasthan. On the border of Rajasthan and Sind (Pakistan) at the village Nimla, Barmer district in the Jodhpur Division, material almost identical with *M. condensata* has been discovered during a recent botanical excursion by the junior author. The original material of the latter was first collected by Dalzell in Sind and deposited in the Kew Herbarium. It was described by Baker as a new species in 1887(1).

Besides recording the above, three distinct new forms have been recognised in the aquatic flora of Rajasthan from Jaipur, Alwar, and Udaipur. These latter will be described as new varieties of *M. minuta* and *M. ballardii* by one of us in a separate paper after the presentation of a Ph.D. thesis on the morphology and systematics of *Marsilea* in Rajasthan. The material constituting these new forms has already been listed in our previous paper (Nos. 93, 105, 113, 125, and 114). The real *M. ballardii* with normal sporocarps found at the famous historical place Amer near Jaipur is listed as No. 196 in the present paper with the diagram of its sporocarp in fig. 11. It may be noted that the original material from Ajmer on which the species was earlier founded contains only abnormal sporocarps and is to be now regarded as a distinct variety of true *M. ballardii*. It has been collected from Kota recently, thus increasing the range of distribution of this sterile variety in Rajasthan. (Nos. 86 and 198).

ACKNOWLEDGEMENT

In conclusion, the authors express their gratitude to Professor T. R. Narayanan of Coimbatore, Dr. G. S. Puri of the Botanical Survey of India, Western Circle, Poona, and the Professor of Botany, Central

College, Bangalore for kindly sending their material to us for examination, and hope that further collections will be forthcoming for study and research.

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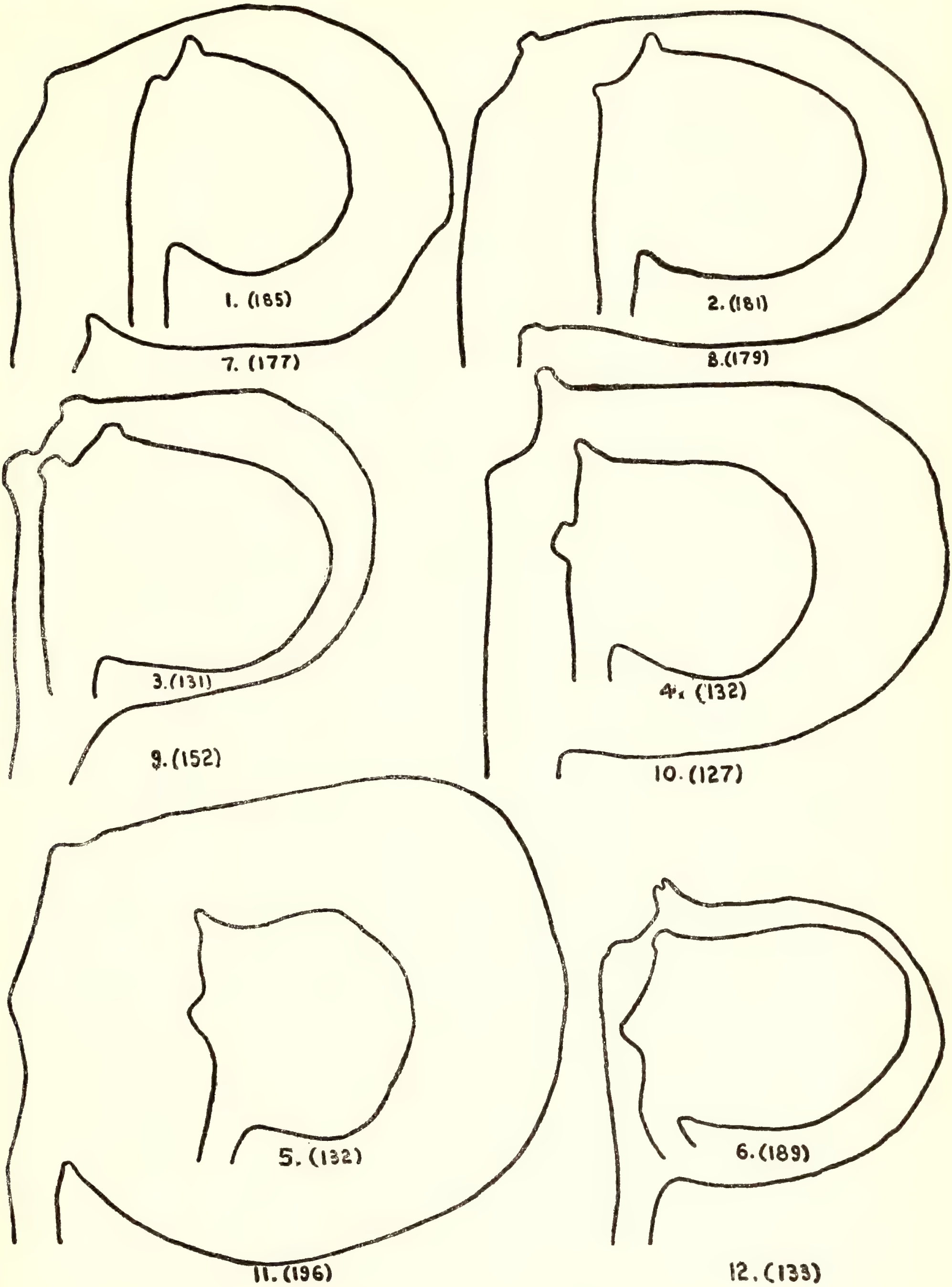
6. Gupta, K. M. and Bhardwaja, T. N. (1957): Indian Marsileas: their Morphology and Systematics—2. On the Examination of some collections of *Marsilea* in India. *JBNHS* **54:** 550-567.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
		E. Madras Herbarium, Coimbatore	
127-30	*Marsilea minuta*	Sheet Nos. 60264-67 ; Nagari, N. Arcot ; 17 March 1917.	Pedicels free & basal ; sporocarps distinctly bordered and indistinctly ribbed ; horns two, upper pointed, lower blunt ; soral no. 14 ; abnormal.
*131	*M. minuta*	Sheet no. 60268 ; Rumpa Hills, Godavari District ; February 1885 ; J. S. Gamble.	Pedicels slightly connate and basal ; sporocarps bordered and indistinctly ribbed ; horns two small, almost similar ; soral no. 8-9 ; normal.
*132	*Marsilea* cf. *brachycarpa*	Sheet no. 60269 ; Janser-choultry near Madras ; February 1859.	Pedicels free and basal ; sporocarps distinctly bordered and ribbed ; horns two, upper longer and pointed vertically or forwards, lower blunt ; soral no. 6-7 ; normal.
*133	*M. minuta*	Sheet no. 60270 ; West Gangapur ; December 1883; J. S. Gamble.	Pedicels connate and slightly adnate or basal ; sporocarps not bordered and indistinctly ribbed ; horns two, similar, upper pointed, lower blunt ; soral no. 10-11 ; normal.
*134-35	*M. minuta*	Sheet nos. 60271-72 ; Madras ; 3 March 1899 ; C. A. Barber.	Pedicels free and basal ; sporocarps bordered and ribbed ; horns two, almost similar ; soral no. 11-12 ; abnormal.
136-37	*M. minuta*	Sheet nos. 60273-74 ; Vandalur, Chingleput ; 9 February 1915.	absent.
138	*M. minuta*	Sheet no. 60275 ; Tarukurungudi, Tinnevelly ; 17 September 1916.	absent.


1. (185)
7. (177)
2. (181)
8. (179)
3. (131)
9. (152)
4. (132)
10. (127)
5. (132)
11. (196)
6. (189)
12. (133)

INDIAN MARSILEAS

TEXT FIGS. 1-12: The numbers in the brackets indicate the serial number of the table, i.e. the herbarium sheet from which the outline of the sporocarp has been drawn. All figures are magnified *ca.* × 16.

139-43	*M. minuta*	.. Sheet nos. 60276-80 ; Vandalur, Chingleput ; 9 February 1915.	absent.
144	*M. quadrifolia*	.. Sheet no. 60281 ; Theruporus ; 1878 ; J. Abbaynaidu.	absent.
*†145	*M. minuta*	.. Sheet no. 60282 ; Gullenj, Ganjam District ; January 1884 ; J. S. Gamble.	Pedicels free and basal; sporocarps indistinctly bordered and not ribbed ; horns two, upper slightly longer and pointed ; soral no. 12-13 ; normal.
146-47	*M. quadrifolia*	.. Sheet nos. 60283-84 ; Tanampatay ; 1879 ; G. Bidie, M.B.	absent.
*148	*M. minuta*	.. Sheet no. 60285	Pedicels free and basal ; sporocarps bordered and ribbed ; upper pointed, horn present, lower obscure ; soral no. 12-13 ; normal.
149	*Marsilea* sp.	.. Sheet no. 60286 ; Central Farm, Coimbatore ; December 1912.	absent.
150	*M. minuta*	.. Sheet no. 018609 ; The College of Science, Trivandrum.	Pedicels free and basal ; sporocarps indistinctly bordered and distinctly ribbed ; horns two, similar ; abnormal.
151	*M. minuta*	.. Sheet no. 80153 ; Ammapettai village, District S. Arcot, 25 August 1930.	absent.
152-53	*M. minuta*	.. Sheet no. 80631 ; Surpanam Chavadi, District S. Arcot ; 4 February 1931 ; V. Narayanswami.	Pedicels slightly connate or free and basal ; sporocarps bordered and indistinctly ribbed ; horns two, upper longer and pointed, lower blunt ; abnormal.

*Species redetermined by the present authors.

† Same as no. 16 of Calcutta Herbarium.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA—(*Contd.*)

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
154-55	*M. minuta*	.. Sheet nos. 80711 ; Ponnankani, Medu, District S. Arcot ; 6 February 1931 ; V. Narayanswami.	absent.
156-57	*M. minuta*	.. Sheet nos. 81326 ; Hassanur, District Coimbatore ; 10 March 1931 ; K. C. Jacob.	absent.
		F. Herbarium, Botanical Survey of India, Western Circle, Poona-4	
†*158-59	*M. minuta*	.. Sheet nos. 38 ; Near Pond, Khandala ; 21 March 1956 ; S. K. Jain.	Pedicels free or slightly connate and basal ; horns two, almost similar ; soral no. 8-10 ; normal.
†*160-61	*M. minuta*	.. Sheet nos. 46 ; Khandala ; 21 March 1956 ; S. K. Jain.	Pedicels free or slightly connate and basal ; horns two, almost similar ; soral no. 8-10 ; normal.
162	*M. quadrifolia*	.. Sheet no. 7235 ; Vithalwadi ; 28 September 1956 ; S. D. Mahajan.	absent.
163	*M. quadrifolia*	.. Sheet no. 8208 ; Pond, Poona ; 18 October 1956 ; S. K. Jain.	absent.
164	*M. quadrifolia*	.. Sheet no. 8310 ; Talegaon ; 12 October 1956 ; S. D. Mahajan.	absent.
165	*M. quadrifolia*	.. Sheet no. 8329 ; Bhosari Lake, Poona-Nasik Road ; 16 October 1956 ; S. D. Mahajan.	absent.
‡166	*M. quadrifolia*	.. Sheet no. 9714 ; Madh Island, Bombay ; 16 December 1956 ; S. K. Jain.	absent.

167-68	*Marsilea* sp. ..	Sheet no. 13265; Raver, Khandesh; 13 March 1957; S. D. Mahajan.	absent.
†*169-70	*M. minuta* ..	Sheet no. nil; Forebay, Khandala; 18 April 1956; S. K. Jain.	Pedicels free or slightly connate and basal; horns two, almost similar; soral no. 8-10; normal.

G. Herbarium, Botany Department, Central College, Bangalore

171	*Marsilea* sp. ..	(1) Sheet no. 30; Bangalore; 14 December 1954; B. Phalaksa.	absent.
*172	*M. minuta* ..	(2) Sheet no. 37; Bangalore; 1955; N. K. Sukanya.	Pedicels slightly connate or free; sporocarps bordered but not ribbed; horns two almost similar; soral no. 13-15; normal.
173	*M. minuta* ..	(3) Sheet no 8; Lal Bagh, Bangalore; 10 February 1951; R. G. Mannada Rani.	Pedicels free and basal; sporocarps not bordered and not ribbed; horns two, upper slightly longer and pointed; lower blunt; soral no. 13; abnormal.
*174	*M. minuta* ..	(4) Sheet no. 68; Kempambudi, Bangalore; 1955; K. M. Khudaija.	Pedicels free and basal; sporocarps bordered but not ribbed; horns two, similar; soral no. 12-15; normal.
*175	*Marsilea* cf. *brachypus* ..	(5) Bangalore; January 1952; M. Gopalaswami.	Pedicels slightly connate or free and basal; sporocarps bordered and slightly ribbed; horns two, upper pointed and longer; normal.
176	*M. vestita* (?) ..	(6) Sheet no. 43; Kemppamudikere, Bangalore; M. Nazir Ahmed.	absent.

*Species redetermined by the present authors.

†Similar to nos. 20, 21, 22 of Blatter Herbarium, Bombay.

‡Similar to no. 123 of Jaswant College Herbarium, Jodhpur.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA—(*Contd.*)

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
154-55	*M. minuta* ..	Sheet nos. 80711 ; Ponnankani, Medu, District S. Arcot ; 6 February 1931 ; V. Narayanswami.	absent.
156-57	*M. minuta* ..	Sheet nos. 81326 ; Hassanur, District Coimbatore ; 10 March 1931 ; K. C. Jacob.	absent.

F. Herbarium, Botanical Survey of India, Western Circle, Poona-4

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
†*158-59	*M. minuta* ..	Sheet nos. 38 ; Near Pond, Khandala ; 21 March 1956 ; S. K. Jain.	Pedicels free or slightly connate and basal ; horns two, almost similar ; soral no. 8-10 ; normal.
†*160-61	*M. minuta* ..	Sheet nos. 46 ; Khandala ; 21 March 1956 ; S. K. Jain.	Pedicels free or slightly connate and basal ; horns two, almost similar ; soral no. 8-10 ; normal.
162	*M. quadrifolia* ..	Sheet no. 7235 ; Vithalwadi ; 28 September 1956 ; S. D. Mahajan.	absent.
163	*M. quadrifolia* ..	Sheet no. 8208 ; Pond, Poona ; 18 October 1956 ; S. K. Jain.	absent.
164	*M. quadrifolia* ..	Sheet no. 8310 ; Talegaon ; 12 October 1956 ; S. D. Mahajan.	absent.
165	*M. quadrifolia* ..	Sheet no. 8329 ; Bhosari Lake, Poona-Nasik Road ; 16 October 1956 ; S. D. Mahajan.	absent.
‡166	*M. quadrifolia* ..	Sheet no. 9714 ; Madh Island, Bombay ; 16 December 1956 ; S. K. Jain.	absent.
167-68	*Marsilea* sp. ..	Sheet no. 13265 ; Raver, Khandesh ; 13 March 1957 ; S. D. Mahajan.	absent.
†*169-70	*M. minuta* ..	Sheet no. nil ; Forebay, Khandala ; 18 April 1956 ; S. K. Jain.	Pedicels free or slightly connate and basal ; horns two, almost similar ; soral no. 8-10 ; normal.

G. Herbarium, Botany Department, Central College, Bangalore

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
171	*Marsilea* sp. ..	(1) Sheet no. 30 ; Bangalore ; 14 December 1954 ; B. Phalaksa.	absent.
*172	*M. minuta* ..	(2) Sheet no. 37 ; Bangalore ; 1955 ; N. K. Sukanya.	Pedicels slightly connate or free ; sporocarps bordered but not ribbed ; horns two almost similar ; soral no. 13-15 ; normal.
173	*M. minuta* ..	(3) Sheet no 8 ; Lal Bagh, Bangalore ; 10 February 1951 ; R. G. Mannada Rani.	Pedicels free and basal ; sporocarps not bordered and not ribbed ; horns two, upper slightly longer and pointed ; lower blunt ; soral no. 13 ; abnormal.
*174	*M. minuta* ..	(4) Sheet no. 68 ; Kempambudi, Bangalore ; 1955 ; K. M. Khudaija.	Pedicels free and basal ; sporocarps bordered but not ribbed ; horns two, similar ; soral no. 12-15 ; normal.
*175	*Marsilea* cf. *brachypus* ..	(5) Bangalore ; January 1952 ; M. Gopalaswami.	Pedicels slightly connate or free and basal ; sporocarps bordered and slightly ribbed ; horns two, upper pointed and longer ; normal.
176	*M. vestita* (?) ..	(6) Sheet no. 43 ; Kemppamudikere, Bangalore ; M. Nazir Ahmed.	absent.

*Species redetermined by the present authors.
†Similar to nos. 20, 21, 22 of Blatter Herbarium, Bombay.
‡Similar to no. 123 of Jaswant College Herbarium, Jodhpur.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
*177	*M. minuta* (?)	(7) Sheet no. 31 ; Bangalore ; 8 January 1956 ; D. Vasantappa.	Pedicels attached in a linear sequence on the petiole at a little distance from each other ; sporocarps bordered but not ribbed ; horns two, obscure, similar ; soral no. 12 ; abnormal ?
*178	*M. minuta*	(8) Sheet no. 28 ; Kempambudi Tank, Bangalore ; Suraiya Jabeen.	Pedicels free and basal ; sporocarps bordered but not ribbed ; horns two, similar ; soral no. 11-12 ; normal.
*179	*M. minuta*	(9) Sheet no. 114 ; Lal Bagh, Bangalore ; 9 March 1950 ; T. R. Balachandra Naidu.	Pedicels free and basal ; sporocarps not bordered and not ribbed ; horns two, upper slightly longer and pointed, lower blunt ; soral no. 13 ; abnormal.
*180	*Marsilea* cf. *gracilenta*	(10) Visveshpuram, Bangalore ; 2 February 1932 ; Jayamma Anandiah.	Pedicels basal and free ; sporocarps not bordered and not ribbed ; horns two, blunt and weaker.
*181	*Marsilea* cf. *brachycarpa*	(11) Near Yedan, Bangalore ; 12 August 1946 ; Padma Bai, P.	Pedicels free or slightly connate and basal ; sporocarps bordered and indistinctly ribbed ; horns two, upper slightly longer ; soral no. 8-10 ; normal.
*182	*M. minuta*	(12) Kempambudi Tank, Bangalore ; January 1952; K. G. Basavanna,	Pedicels free and basal ; sporocarps slightly bordered but not ribbed ; horns two, similar ; soral no. 12-14 ; abnormal ?
*183	*M. minuta*	(13) Peenya Forest, Bangalore ; G. Giriappa.	Pedicels connate and basal ; sporocarps not bordered and not ribbed ; horns two, similar, weaker ; soral no. 16 ; abnormal (?)
184	*M. quadrifolia*	(14) Chennamma tankere, Bangalore 1954-55 ; B. R. Leelavathi.	Absent.

*185	*Marsilea* cf. *brachycarpa*	(15) Kankanhalli, Bangalore District, Mysore State; 5 October 1946; A. Nagaraja Rao.	Pedicels connate and basal; sporocarps not bordered and indistinctly ribbed; horns two, upper pointed and slightly longer; soral no. 9-10; normal.
186	*Marsilea* sp.	(16) Sheet no. 29; Nanjangud; 3 January 1954; N. S. Rangaswamy.	Absent.
187	*Marsilea* sp.	(17) Sheet no. 30; Nanjangud; 7 January 1954; N. S. Rangaswamy.	Absent.
*188	*Marsilea* cf. *brachypus*	(18) Hesarghatta, Bangalore District; January 1946; M. D. Mahadev.	Pedicels basal and solitary (?); sporocarps not bordered and not ribbed; horns two, similar, upper longer and pointed, lower blunt.
*189	*Marsilea* cf. *tenuifolia*	(19) Kemmannugundi, Western Ghats, Mysore State; 23 December 1943; N. Ranzanua.	Pedicels connate and basal; sporocarps distinctly bordered and ribbed; horns two, upper pointed, lower blunt; soral no. 7-9; normal; leaflets oblanceolate, entire.
*190	*Marsilea* cf. *gracilenta*	(20) Kemmannugundi, Western Ghats, Mysore State, December 1943; Shanta, V.	Pedicels connate and basal; sporocarps not bordered and not ribbed; horns obscure; soral no. 11-13; abnormal.
*191	*Marsilea* cf. *brachypus*	(21) Bannerughatta, Bangalore District; A. V. Narasimataswamy.	Pedicels attached in a linear sequence on the petiole at a little distance from each other; sporocarps indistinctly bordered and not ribbed; horns two, upper longer and pointed, lower blunt.
192	*Marsilea* sp.	(22) Lakkavalli, Mysore State; 13 October 1953; C. V. Venkata Ramu.	Absent.
193	*Marsilea* sp.	(23) Savanadurga, Bangalore District; February 1950; J. Sharada Bias.	Absent.

*Species redetermined by the present authors.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
*177	*M. minuta* (?)	(7) Sheet no. 31 ; Bangalore ; 8 January 1956 ; D. Vasantappa.	Pedicels attached in a linear sequence on the petiole at a little distance from each other ; sporocarps bordered but not ribbed ; horns two, obscure, similar ; soral no. 12 ; abnormal ?
*178	*M. minuta*	(8) Sheet no. 28 ; Kempambudi Tank, Bangalore ; Suraiya Jabeen.	Pedicels free and basal ; sporocarps bordered but not ribbed ; horns two, similar ; soral no. 11-12 ; normal.
*179	*M. minuta*	(9) Sheet no. 114 ; Lal Bagh, Bangalore ; 9 March 1950 ; T. R. Balachandra Naidu.	Pedicels free and basal ; sporocarps not bordered and not ribbed ; horns two, upper slightly longer and pointed, lower blunt ; soral no. 13 ; abnormal.
*180	*Marsilea* cf. *gracilenta*	(10) Visveshpuram, Bangalore ; 2 February 1932 ; Jayamma Anandiah.	Pedicels basal and free ; sporocarps not bordered and not ribbed ; horns two, blunt and weaker.
*181	*Marsilea* cf. *brachycarpa*	(11) Near Yedan, Bangalore ; 12 August 1946 ; Padma Bai, P.	Pedicels free or slightly connate and basal ; sporocarps bordered and indistinctly ribbed ; horns two, upper slightly longer ; soral no. 8-10 ; normal.
*182	*M. minuta*	(12) Kempambudi Tank, Bangalore ; January 1952; K. G. Basavanna,	Pedicels free and basal ; sporocarps slightly bordered but not ribbed ; horns two, similar ; soral no. 12-14 ; abnormal ?
*183	*M. minuta*	(13) Peenya Forest, Bangalore ; G. Giriappa.	Pedicels connate and basal ; sporocarps not bordered and not ribbed ; horns two, similar, weaker ; soral no. 16 ; abnormal (?)
184	*M. quadrifolia*	(14) Chennamma tankere, Bangalore 1954-55 ; B. R. Leelavathi.	Absent.
*185	*Marsilea* cf. *brachycarpa*	(15) Kankanhalli, Bangalore District, Mysore State; 5 October 1946 ; A. Nagaraja Rao.	Pedicels connate and basal ; sporocarps not bordered and indistinctly ribbed ; horns two, upper pointed and slightly longer ; soral no. 9-10 ; normal.
186	*Marsilea* sp.	(16) Sheet no. 29 ; Nanjangud ; 3 January 1954 ; N. S. Rangaswamy.	Absent.
187	*Marsilea* sp.	(17) Sheet no. 30 ; Nanjangud ; 7 January 1954 ; N. S. Rangaswamy.	Absent.
*188	*Marsilea* cf. *brachypus*	(18) Hesarghatta, Bangalore District ; January 1946 ; M. D. Mahadev.	Pedicels basal and solitary (?) ; sporocarps not bordered and not ribbed ; horns two, similar, upper longer and pointed, lower blunt.
*189	*Marsilea* cf. *tenuifolia*	(19) Kemmannugundi, Western Ghats, Mysore State ; 23 December 1943 ; N. Ranzanua.	Pedicels connate and basal ; sporocarps distinctly bordered and ribbed ; horns two, upper pointed, lower blunt ; soral no. 7-9 ; normal ; leaflets oblanceolate, entire.
*190	*Marsilea* cf. *gracilenta*	(20) Kemmannugundi, Western Ghats, Mysore State, December 1943 ; Shanta, V.	Pedicels connate and basal ; sporocarps not bordered and not ribbed ; horns obscure ; soral no. 11-13 ; abnormal.
*191	*Marsilea* cf. *brachypus*	(21) Bannerughatta, Bangalore District ; A. V. Narasimataswamy.	Pedicels attached in a linear sequence on the petiole at a little distance from each other ; sporocarps indistinctly bordered and not ribbed ; horns two, upper longer and pointed, lower blunt.
192	*Marsilea* sp.	(22) Lakkavalli, Mysore State ; 13 October 1953 ; C. V. Venkata Ramu.	Absent.
193	*Marsilea* sp.	(23) Savanadurga, Bangalore District ; February 1950 ; J. Sharada Bias.	Absent.

*Species redetermined by the present authors.

DETAILS OF THE COLLECTIONS OF *MARSILEA* IN SOME INDIAN HERBARIA—(*Contd.*)

1 S.N.	2 Name of species	3 Herbarium details	4 Characters of the sporocarps
194	*Marsilea* sp.	(24) Narsimharanjpur, Mysore State; 16 February 1948; Syed Yousuf.	Absent.
195	*Marsilea* sp.	(25) Narsimharajapuram, Western Ghats, Mysore State; January 1947; K. K. Krishnamurthy.	Absent.
H. Herbarium, Botany Department, Jaswant College, Jodhpur			
196	*Marsilea ballardii*	$\frac{\text{45M—10R}}{\text{JP—56}}$; Amer, Jaipur; December 1956; K. M. Gupta.	Pedicels free and basal; sporocarps not bordered and not ribbed; horns two, blunt; soral no. 8-11; normal.
197	*Marsilea* cf. *condensata*	$\frac{\text{46M—10R}}{\text{NM—57}}$; village Nimla, District Barmer; 20 August 1957; T. N. Bhardwaja.	Pedicels basal and solitary; sporocarps not bordered and not ribbed; upper horn present, lower obscure; soral no. 8-10; normal.
198	*M. ballardii* var. nov. (in MS.)	$\frac{\text{47M—30R}}{\text{KO—56}}$; Tank of Nanta, Kota; 20 October 1957; T. N. Bhardwaja.	Pedicels basal and free; sporocarps not bordered and not ribbed; only upper pointed horn present; lower absent; soral no. 9-12; abnormal.
199	*M. aegyptiaca*	$\frac{\text{48M—30R}}{\text{AJ—57}}$; Annasagar Lake, Ajmer; 26 October 1957; T. N. Bhardwaja.	Pedicels basal and solitary; sporocarps square, grooved and depressed; upper blunt horn present; soral no. 4-6; normal.
200	*Marsilea* sp.	$\frac{\text{49M—10R}}{\text{JLD—57}}$; village Raipur, District Jullunder; October 1957; Jag Dutt Dhummy.	Absent.

Notes on a Visit to certain Islands of the Laccadive Archipelago, with special reference to Fisheries[1]

BY

V. BALAN

Central Marine Fisheries Research Sub-station, Kozhikode-5

(*With a map*)

INTRODUCTION

A visit to the Laccadives was undertaken by the author in March 1954 at the suggestion of Dr. S. Jones to get a first-hand knowledge of the fishery conditions there and to ascertain if pelagic fishes of economic importance found along the Malabar Coast occur also in this area in appreciable numbers during the different seasons. It was felt that this information might be of value in any expanded programme of fisheries investigations taken up for the west coast of India. I was able to spend about a month in the Laccadives visiting the islands Agathi, Kavarathi, Ameni, and Kadamat.

The information we have on the Laccadive fisheries is based on the observations of Alcock (1902), Hornell (1908), Ayyangar (1922), and on the notes given by Ellis (1924), Burton (1940), and Mathew and Ramachandran (1956).

The Laccadives consist of a group of coral islands lying between Long. 71° 40′ and 74°E., and Lat. 8° and 12°N. in the Arabian Sea (see map). There are ten inhabited islands in all, of which the southern five, namely Minicoy, Agathi, Kavarathi, Kalpeni, and Androth are known as the Malabar Islands, and the northern five, namely Ameni, Kadamat, Chetlat, Kiltan, and Bitra are called the Amindivi or S. Kanara Islands. The inhabitants of all the islands are Muslims. Except for the people of Minicoy who speak Mahl dialect, the others are settlers from Malabar and speak Malayalam. Besides these islands, there are a few uninhabited ones which are frequented by the islanders for fishing operations.

JOURNEY TO THE ISLANDS AND BACK

There is no regular transport facility between the islands and the mainland of India. The journey was, therefore, undertaken in a country craft or *odam* named ‘ Hydrose ’. On the morning of 21st March our vessel set sail to Agathi Island, about 223 miles from Mangalore. The voyage was uneventful except that the major sail rope snapped against a heavy wind during the midnight of 23rd-24th and the *odam* went out of control and rolled violently in the choppy sea for about an hour till the defect was rectified. On the evening of 24th March we landed in Agathi.

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[1] Published with the kind permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

During my five days' stay at Agathi, I collected some fish specimens and information relating to methods of fishing, commercially important fishes, and the fishing industry in general. We left in a sailing vessel on the night of 29th March for Kavarathi, about 33 miles from Agathi, which we reached the next day afternoon. After the completion of my work there, I proceeded to Ameni Island, about 36 miles from Kavarathi on the night of 5th April. We could land at Ameni only at about sunrise on the 7th April. On the morning of 11th April I went to Kadamat Island, about 8 miles north of Ameni. From Kadamat I returned to Ameni on the 17th noon from where I started on my return trip in the *odam* named 'Mandum Kuthira' proceeding to the mainland on the 18th, and reached Mangalore on 22nd April.

FISH AND FISHERIES ON THE ISLANDS

The fishes occurring in the coralline niches of the lagoon* exhibit the characteristic variety of colours and they consist of perches, gar-fishes, half-beaks, scarids, goat-fishes, carangids, grey mullets, atherinids, sphyraenids, polynemids, balistids, blennids, and globe-fishes.

The offshore fishery is constituted by fishes such as seer-fish, sharks, sail fish, tunnies, flying-fish, carangids, and ribbon fish. Besides these, rays and skates are obtained frequently.

The period extending from September to the end of December is considered very favourable both for the offshore and lagoon fisheries of these islands. The flying-fishes are reported to occur throughout the year, but in decreasing numbers from December to February. Their fishery is lucrative during March, April, and May.

Moderate numbers of tunnies are said to occur from October to January off these islands and it is reported by the island fishermen that the fish are commonly caught from the 20-fathom area and beyond. Only small boats, manned by four each, are used for fishing tunnies by hook and line. They do not use live bait, except in Minicoy.

Agathi Island: Situated Long. 78° 28′E. and Lat. 10° 51′ 30″N., the island is 3½ miles long and about 1,000 yards broad at its broadest point, having an area of 688 acres and a population of 2,038†. Coral reefs which encircle the island afford protection from heavy breakers. About 200 people are engaged in fishing as an occupation here.

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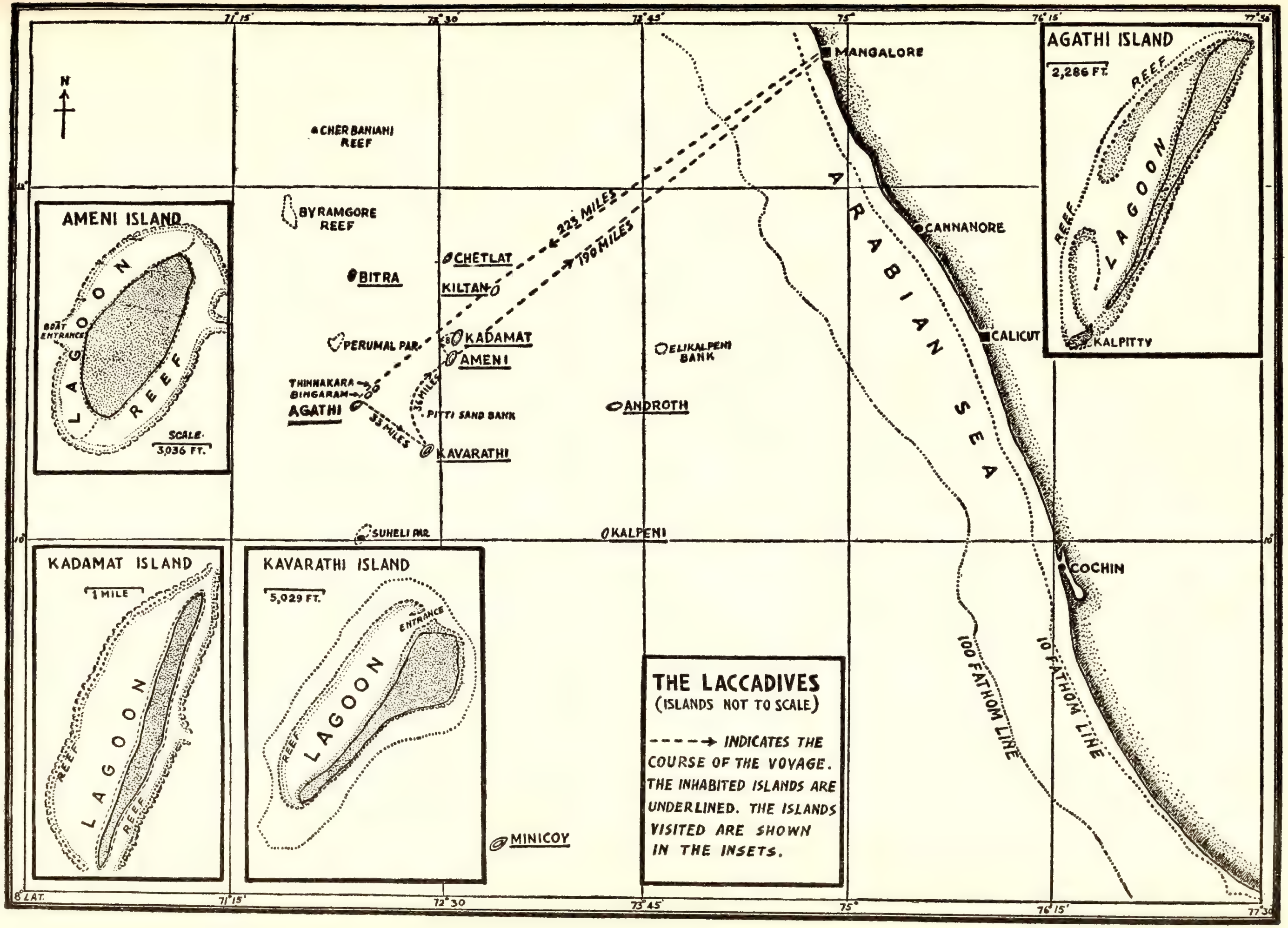
*The term lagoon is used in the broad sense to denote the shallow and smooth sea water situated between the sea-shore and the outer reefs.

†Figures taken from S. Y. Krishnaswami's Report of 1952.


N
AMENI ISLAND
LAGOON
REEF
BOAT ENTRANCE
SCALE
3,036 FT.
KADAMAT ISLAND
1 MILE
REEF
LAGOON
REEF
KAVARATHI ISLAND
5,029 FT.
ENTRANCE
REEF
LAGOON
AGATHI ISLAND
2,286 FT.
REEF
LAGOON
REEF
KALPITTY
CHERBANIANI REEF
BYRAMGORE REEF
BITRA
CHETLAT
KILTAN
PERUMAL PAR
KADAMAT
AMENI
THINNAKARA
BINGARAM
AGATHI
33 MILES
35 MILES
PITTI SAND BANK
KAVARATHI
223 MILES
190 MILES
ELIKALPENI BANK
ANDROTH
SUHELI PAR
KALPENI
MINICOY
MANGALORE
CANNANORE
CALICUT
COCHIN
ARABIAN SEA
100 FATHOM LINE
10 FATHOM LINE
THE LACCADIVES
(ISLANDS NOT TO SCALE)
----→ INDICATES THE COURSE OF THE VOYAGE. THE INHABITED ISLANDS ARE UNDERLINED. THE ISLANDS VISITED ARE SHOWN IN THE INSETS.
71°15'
72°30'
73°45'
75°
76°15'
77°30'
8° LAT.
10°
11°

THE LACCADIVE GROUP

Agathi, Kavarathi, Ameni, and Kadamat Islands in the insets are after R.H. Ellis

12 species of fishes belonging to 7 families as listed elsewhere (see table) were collected from here.

Kavarathi Island: The island (Long. 72° 57′E. and Lat. 10° 34′N.), about 3½ miles long and about ¾ mile broad, has an area of 865 acres and a population of 2,500*. Ayyangar (1922) is reported to have observed living pearl oysters here. There are about 400 men engaged in fishing here according to the report of the islanders.

From this island, I collected on the whole 23 species of fishes belonging to 15 families (see table).

Ameni Island: The island (Long. 72° 45′E. and Lat. 11° 5′N.) is about 2 miles long and over a mile wide. It has an area of 622 acres and a population of 4,000. The lagoon adjoining this island is comparatively richer in its fish wealth than the three islands already mentioned. Here there are about 200 fishermen.

I was able to collect 54 species of fishes belonging to 27 families (see table) from here.

Kadamat Island: The island, situated Long. 72° 6′E. and the Lat. 11° 33′N., is about 5 miles long and 600 yards wide. It has an area of 748 acres and a population of 2,000. There are about 500 fishermen here. Ayyangar (1922) observed dead young pearl oysters in the southern region of the island.

10 species of fishes belonging to 7 families were collected from here (see table).

LIST OF FISHES

COLLECTED FROM THE LACCADIVES †

TABLE I

Name	Agathi	Kavarathi	Ameni	Kadamat
Family Sphyrnidae				
1. *Sphyrna blochii* (Cuvier)	—	—	—	+
Family Synodontidae				
2. *Synodus indicus* (Day)	—	—	+	—
Family Belonidae				
3. *Belone* (*Eurycaulus*) *persimilis* Günther	—	—	+	—
4. *Tylosurus leiurus* (Bleeker)	+	—	—	—

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*Figures taken from S. Y. Krishnaswami's Report of 1952.

†The classification is after Jordan (1923) : A CLASSIFICATION OF FISHES. Stanford University, California.

TABLE I—(*contd.*)

Name	Agathi	Kavarathi	Ameni	Kadamat
Family Hemirhamphidae				
5. *Hemirhamphus dussumieri* Cuvier & Valenciennes	—	—	+	+
Family Exocoetidae				
6. *Cypselurus atrisignis* Jenkins	+	+	+	+
7. *Cypselurus comatus*** (Mitchill)	+	+	+	+
Family Bothidae				
8. *Bothus* (*Platophrys*) *pantherinus* (Rüppell)	—	—	+	—
Family Pegasidae				
9. *Pegasus draconis* Linnaeus	—	+	—	—
Family Fistularidae				
10. *Fistularia petimba* (Lacépèd)	—	—	+	—
Family Atherinidae				
11. *Allanetta forskali* (Rüppell)	—	—	+	—
Family Mugilidae				
12. *Crenimugil crenilabis* (Forskal)	—	—	—	+
Family Sphyraenidae				
13. *Sphyraena obtusata* Cuvier	—	—	+	—
Family Polynemidae				
14. *Polynemus sexfilis* Valenciennes	—	+	+	—
Family Carangidae				
15. *Caranx* (*Caranx*) *sexfasciatus* Quoy & Gaimard	+	—	+	—
16. *Selar crumenophthalmus* (Bloch)	+	—	—	—
17. *Caranx oblongus* ? (Cuvier)	—	—	+	—
18. *Trachinotus bailloni* (Lacépède)	—	—	+	—
Family Apogonidae				
19. *Apogon frenatus* Valenciennes	—	+	—	—
Family Serranidae				
20. *Epinephelus merra* Bloch	—	+	+	—
21. *Kuhlia taeniurus* (Cuvier)	—	—	+	+

**Same as *Cypselurus bahiensis* (Ranzani) of Weber & Beaufort (1922) according to Bruun (1935)

TABLE I—(*contd.*)

Name	Agathi	Kavarathi	Ameni	Kadamat
Family Lutianidae				
22. *Lutianus kasmira* (Forskal)	—	+	+	—
23. *Lutianus gibbus* (Forskal)	—	+	+	—
24. *Lutianus johni* (Bloch)	+	—	—	—
Family Lethrinidae				
25. *Lethrinus rhodopterus* Bleeker	—	—	+	—
26. *Lethrinus ornatus* Valenciennes	—	—	+	—
27. *Lethrinus frenatus* Valenciennes	—	—	+	—
28. *Lethrinus nebulosus* (Forskal)	—	—	+	—
29. *Lethrinus hypselopterus* ? Bleeker	—	—	+	—
30. *Lethrinus ramak* (Forskal)	—	+	—	—
31. *Monotaxis grandoculis* (Forskal)	—	—	+	—
Family Gerridae				
32. *Gerres oblongus* Cuvier	—	—	—	+
Family Mullidae				
33. *Mulloidichthys samoensis* (Günther)	+	—	—	+
34. *Pseudupeneus pleurospilos* (Bleeker)	—	—	+	—
35. *Pseudupeneus macronema* (Lacépéde)	+	—	+	—
36. *Parupeneus trifasciatus* (Lacépède)	—	—	+	—
Family Chaetodontidae				
37. *Anisochaetodon* (*Linophora*) *auriga* (Forskal)	—	—	+	—
38. *Chaetodon* (*Rhabdophorus*) *trifasciatus* Mungo Park	—	—	+	—
39. *Chaetodon xanthocephalus* Bennett	+	—	—	—
Family Zanclidae				
40. *Zanclus cornutus* (Linnaeus)	—	—	+	—

TABLE I—(*contd.*)

	Name	Agathi	Kavarathi	Ameni	Kadamat
41.	*Zanclus canescens* (Linnaeus)	—	—	+	—
Family	Acanthuridae				
42.	*Acanthurus triostegus* (Linnaeus)	+	—	+	—
43.	*Acanthurus leucosternon* Bennett	+	—	+	—
44.	*Acanthurus lineatus* (Linnaeus)	+	—	+	—
45.	*Acanthurus tennentii* (Günther)	—	—	+	—
46.	*Naso tuberosus* Lacépède	—	+	—	—
47.	*Naso unicornis* (Forskal)	—	+	—	—
Family	Siganidae				
48.	*Siganus oramin* (Schneider)	—	—	+	—
Family	Scorpaenidae				
49.	*Scorpaenopsis cirrhosa* ? Day (*nec.* Thunberg)	—	—	+	—
50.	*Pterois volitans* (Linnaeus)	—	+	—	—
Family	Pomacentridae				
51.	*Abudefduf septemfasciatus* (Cuvier)	—	—	+	—
52.	*Chromis xanthurus* ? (Bleeker)	—	+	—	—
Family	Coridae				
53.	*Gomphosus varius* Lacépède	—	—	+	—
54.	*Cheilio inermis* (Forskal)	—	—	+	—
55.	*Novaculichthys taeniourus* (Lacépède)	—	—	+	—
56.	*Cymolutes lecluse* (Quoy & Gaimard)	—	+	—	—
57.	*Thalassoma janseni* (Bleeker)	—	—	+	—
58.	*Thalassoma lunare* (Linnaeus)	—	—	+	—
59.	*Thalassoma hardwickii* (Bennett)	—	—	+	—
60.	*Iniistius pavo* (Cuvier & Valenciennes)	—	+	—	—

TABLE I—(*contd.*)

Name		Agathi	Kavarathi	Ameni	Kadamat
61.	*Cheilinus trilobatus* Lacépède	—	—	+	—
62.	*Macropharyngodon meleagris*? (Cuvier & Valenciennes)	—	—	+	—
63.	*Anampses diadematus* Rüppell	—	+	—	—
64.	*Stethojulis* sp.	—	+	—	—
65.	*Halichoeres centiquadrus* (Lacépède)	—	—	+	—
Family	Sparisomidae				
66.	*Cryptotomus spinidens* (Quoy & Gaimard)	—	—	+	—
Family	Scaridae				
67.	*Callyodon ghobban* (Forskal)	—	+	—	—
68.	*Callyodon* sp. I	—	+	—	—
69.	*Callyodon* sp. II	—	—	—	+
70.	*Callyodon* sp. III	—	+	—	+
71.	*Leptoscarus coeruleopunctatus* (Rüppell)	—	+	—	—
Family	Blennidae				
72.	*Salarias fasciatus* (Bloch)	—	—	+	—
73.	*Salarias* sp.	—	+	—	—
Family	Eleotridae				
74.	*Eleotris* sp.	—	—	+	—
Family	Balistidae				
75.	*Rhinecanthus aculeatus* (Linnaeus)	—	—	+	—
76.	*Melichthys ringens* (Osbeck)	—	—	+	—
77.	*Balistes* sp.	—	+	—	—
Family	Monacanthidae				
78.	*Amanses sandwichiensis* (Quoy & Gaimard)	—	—	+	—
Family	Tetraodontidae				
79.	*Arothron nigropunctatus* (Bloch)	—	—	+	—
80.	*Arothron hispidus* (Lacépède)	—	—	+	—

FISHING CRAFT AND GEAR

Boats: The fishing boats of the islands are of the keeled type and are made of wooden planks sewn together with coir ropes. The timber commonly used is of the locally available *Callophyllum inophyllum* (the Indian Laurel) though other varieties brought from the mainland are used sometimes. The boat is manned by one to three men and is provided with a sail. The oars used are made of coco-nut stem. These boats are described by Hornell (1908), Ayyangar (1922), and Mathew and Ramachandran (1956).

'Therappam': This is a wooden raft composed of an aggregate of fifteen to twenty-five light logs of wood tied together and is operated in the lagoon area. It is usually manned by one man. It has been described by Hornell (1946), and Mathew and Ramachandran (1956).

Nets: The following nets are common in all the four islands visited by me. They have been described in detail except (c) by Hornell (1908), Ayyangar (1922), Burton (1940), and Mathew and Ramachandran (1956). So little more is done beyond enumerating them as observed during my visit:

(a) *Kandali vala:* This is a shore-seine used for fishing in lagoon waters.

(b) *Adi vala* or *vidunna vala* : This is similar to *kandali vala* but of smaller mesh. A smaller meshed shore-seine, called *mulu vala,* of Chetlat Island is described by Burton (1940) and is referred to as *moodu vala* by Mathew and Ramachandran (1956).

(c) *Paattu vala :* This is a gill-net which is provided with floats and sinkers. It consists of three or four rectangular pieces of net laced from end to end, and the whole net combination is left anchored in the sea throughout the night. The net is common at Agathi but appears to be not so in the other islands visited by me.

(d) *Veechu vala* or *kotti vala :* This is a cast net operated from shore for catching fishes from the reefs and lagoons. It is not of the closing type. *Mudu vala* is a similar cast net of Chetlat (described by Burton 1940).

Harpoons: (a) *Chattuli* or *uli* (single harpoon) : This is used for spearing fishes, dolphins, turtles, etc. The harpoon is one of the most common fishing implements used in the islands. This has been described by Hornell (1908), Ayyangar (1922), Burton (1940), and Mathew and Ramachandran (op. cit.).

(b) *Kooduli* (three-pronged harpoon) : This three-pronged iron harpoon is used for spearing soft-bodied fishes such as seer fish, sail-fish, tunny, etc. It has been described by Burton (1940), and Mathew and Ramachandran (op. cit.).

(c) *Chilla* (multi-pronged harpoon): A multi-pronged wooden harpoon locally called '*chilla*' is also used for catching flying-fishes, half-beaks, etc. at night. Fishing with this implement is done very successfully during new-moon nights. It has been described by Hornell (op. cit.), Ayyangar (op. cit.), Burton (op. cit.), and Mathew and Ramachandran (op. cit.).

Hook and Line: Line-fishing is practised in all the islands. Small types of hooks are used for fishing in the lagoon area. Fishing in the offshore areas is done with larger hooks. Different sizes of hooks used are described by Hornell (op. cit.), Ayyangar (op. cit.), and Mathew and Ramachandran (op. cit.).

Traps: Trap-fishing is also common in these islands. Traps commonly used there have been described by Hornell (op. cit.), Ayyangar (op. cit.), Burton (op. cit.), and Mathew and Ramachandran (op. cit.). The catches obtained in them are generally small.

Torches: After sunset, during dark nights, flaring bundles of coco-nut leaves are employed to lure the young of certain fishes (Upeneoids and Polynemids largely) towards the boat, and these are caught with the aid of rectangular pieces of cloth (measuring about 5ft. × 4ft.). This method of fishing is more common in Agathi during summer months than in the other islands visited.

GENERAL REMARKS

Fishes, such as sardines, mackerel, soles, silver-bellies, sciaenids, pomfrets, and cat-fishes, which occur in large quantities on the west coast, do not enter the commercial fisheries of the Laccadive Archipelago. Flying-fishes, tuna, sharks, skates, rays, perches, seer-fish, red mullets, gar-fishes, sphyraenids, parrot-fishes, polynemids, balistids, and acanthurids are the economically important fishes occurring in appreciable numbers there. The flying-fishes yield one of the most important fisheries of the islands. Fishes, such as *Crenimugil crenilabis*, *Polynemus sexfilis*, *Naso tuberosus*, *Naso unicornis*, *Gomphousus varius*, *Novaculichthys taeniurus*, *Halichoeres centiquadrus*, and *Anampses diadematus*, though rare on the west Coast are often encountered in the island catches.

Besides fishes dolphins, turtles, edible bivalves, squids, and lobsters are fished in small numbers from the Laccadive sea.

Fishes are cured if there is any surplus catch. Salt-curing is not usually done mainly on account of the scarcity of salt for this purpose. *Kacha-meen*, a kind of cured fish prepared by the islanders, is considered a delicacy there. Curing by sun-drying (i.e. without the application of salt) is also occasionally done. Small fishes are generally dried whole in the sun. Salted octopi and dolphins are considered delicacies and are sometimes eaten raw by the local population.

A kind of crude oil prepared from the liver of sharks and rays is extensively used for smearing over the boats. The fins of sharks are cut out and frequently transported to the mainland where they fetch a good price.

In the light of the above observations it seems clear that the fishery resources around these islands, at present unexploited, will provide an ample yield in future with the introduction of improved fishing crafts and gear.

ACKNOWLEDGEMENTS

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Notes on the Eggs, Tadpoles, Metamorphosis, and Ecology of the Ceylonese Narrow-mouthed Frog *Ramanella obscura* (Günther)

BY

A. M. MORGAN-DAVIES, F.Z.S.

(*With two plates and four text-figures*)

INTRODUCTION

Knowledge of the eggs, tadpoles, life-history, and general ecology of the majority of the Amphibia peculiar to Ceylon is very incomplete, and of the fourteen such species the tadpoles of eight and the eggs and life-histories of all fourteen still await complete investigation. The genus *Ramanella* Rao is represented in Ceylon by three species two of which, *R. palmata* and *R. obscura*, are peculiar to the island; the third, *R. variegata*, occurs also in south India (Parker, 1934; Kirtisinghe, 1957).

This paper describes for the first time the eggs, tadpoles, and metamorphosis of the Narrow-mouthed Frog *Ramanella obscura* (Günther). Also added are a few notes on its ecology.

MATERIALS AND METHODS

Examination of the eggs from freshly-deposited spawn was undertaken with a microscope fitted with an ocular micrometer. The account of the larval stages is taken from a batch of ova deposited in the field. The tadpoles of a second batch of ova deposited in the laboratory were bred at a temperature of 70°-80° F. (24°-27° C.) and fed on mashed spinach. At intervals of five days total length measurements were taken from both batches with a dial caliper and the results recorded (Table 1).

BREEDING ACTIVITY

On 12 October 1957 the north-east monsoon broke over Kandy District and by the 15th a considerable amount of calling was heard from some roadside silt pits at Hantane, about two miles south of

Kandy town (2,600 ft.). On investigation, each flooded silt pit was found to contain up to fifteen loudly-calling *Ramanella obscura*. The call is very similar to that of its related species *R. variegata* which has been described as 'qhauy, qhauy, qhauy' (Rao, 1918), though possibly not so loud. With the exception of two females, all were males that had just arrived at their breeding sites and were floating on the water with their limbs partly extended in an attitude similar to that adopted by *Rana c. cyanophlyctis*, or else clutching floating debris with just their heads and forelegs showing above the water. During the following week females became more numerous and spawn was to be found in most pits. By the 26th, ten days after breeding commenced, there was not a frog to be found but eggs and young tadpoles were left in abundance.

The position during amplexus was semi-pectoral with the arms of the male passing just behind and beneath those of the female, the palms and fingers turned out and digging into the pectoral area. During amplexus the pair never left the water for more than a minute or two, and during these short periods the hindlegs of the male were brought up so that the thighs, shanks, and feet were well together above the waist or thighs of the female (Plate I, fig. 1). When in the water the pair remained afloat, with or without the female clutching some form of support, and with their feet flexed and pointing dorsolaterally at an angle of approximately 45° to the long axis of the

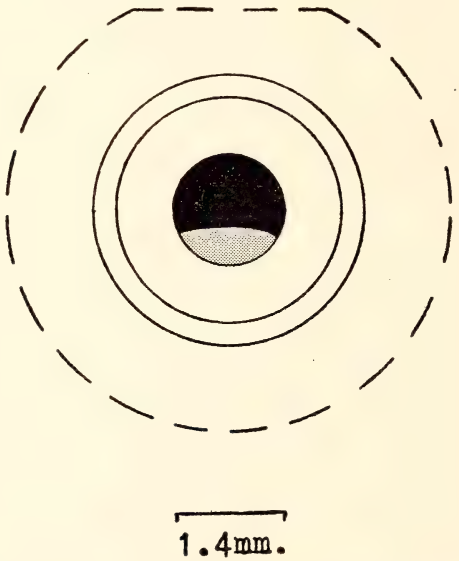
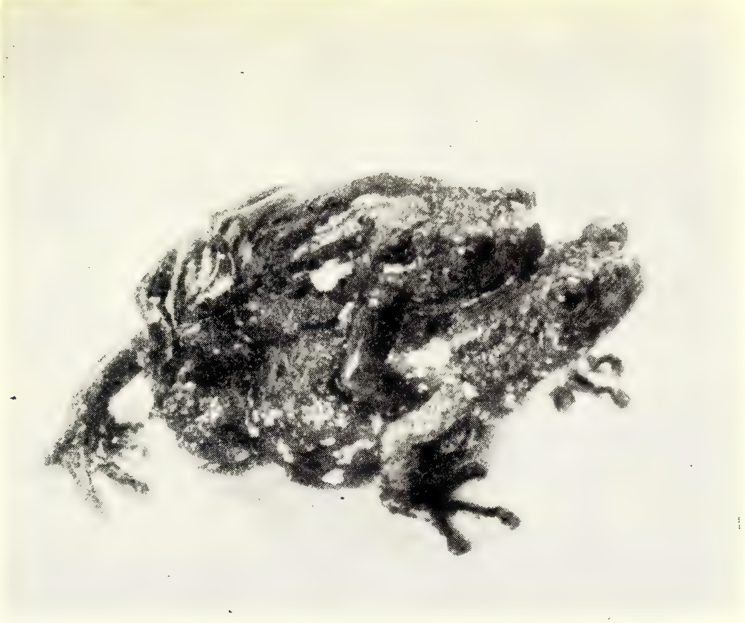
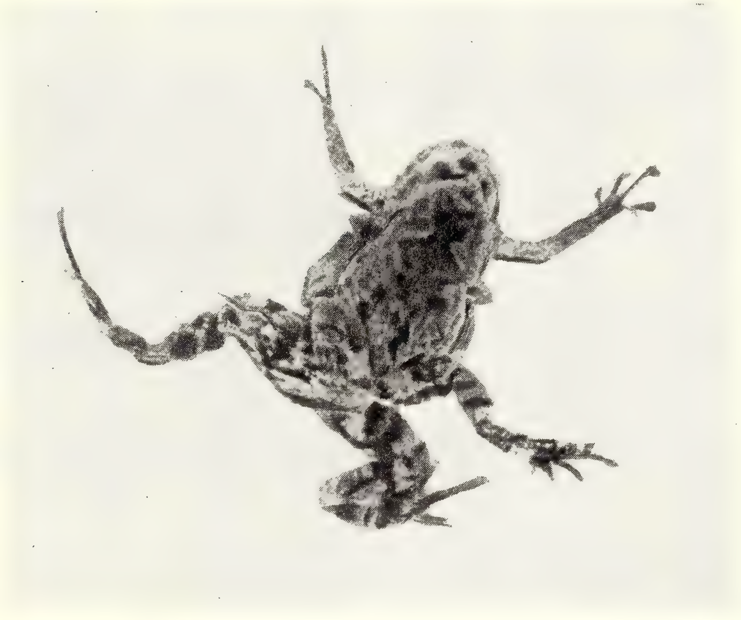


Fig. 1. Diagram of egg. (Broken line indicates loose envelope)

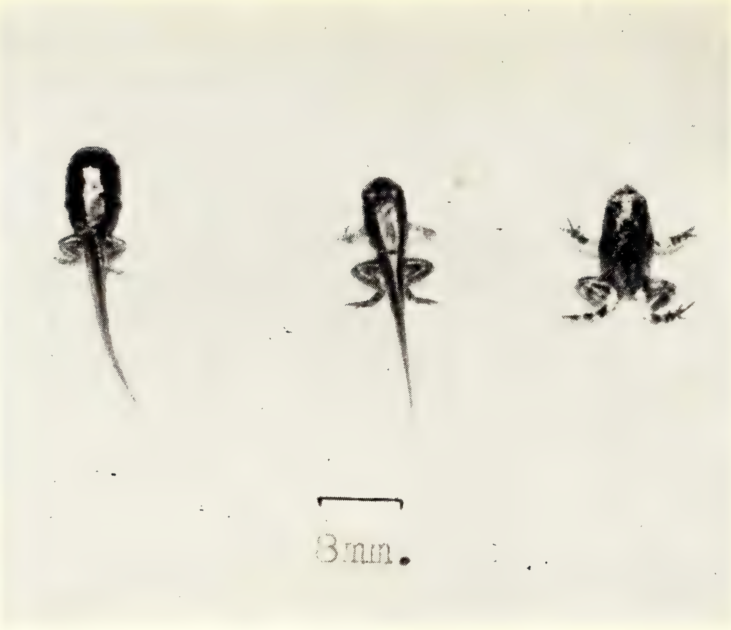


1. Position during amplexus on land

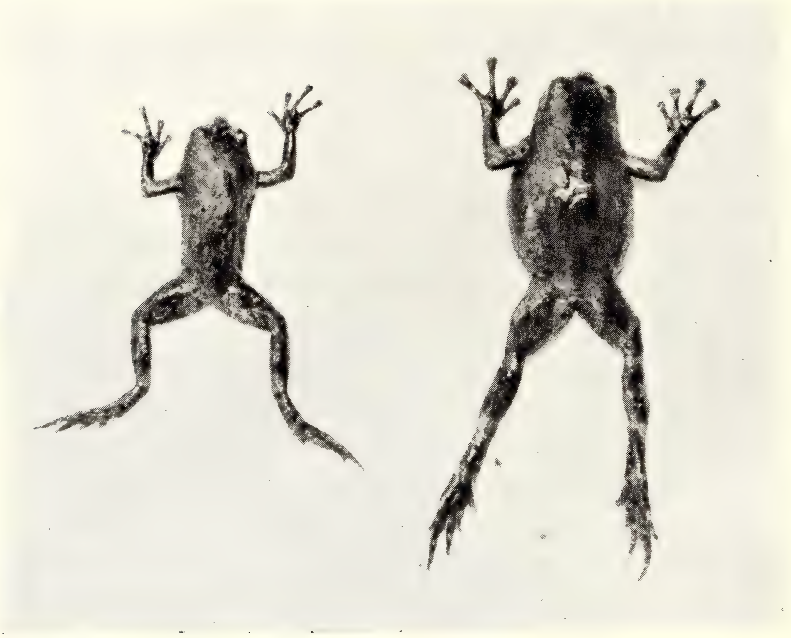


2. Position during amplexus in water

Photos : A. M. Morgan-Davies



1. Larval stages



2. Adult male and female *Ramanella obscura*

Photos : A. M. Morgan-Davies

body (Plate I, fig. 2). From the lateral view the pair float with their nostrils and eyes just clear of the water and their bodies at an angle of approximately 30° to the surface. Unfortunately the act of ova deposition was not observed, though it was noted that in three cases in captivity ova deposition took place between 10 a.m. and 3 p.m.

EMBRYONIC DEVELOPMENT

The egg mass is deposited as a surface film, either in a single mass or more often in small batches, independent of any form of anchorage or support. Should the water be disturbed the eggs are easily separated into smaller batches or single eggs, and throughout the ova stage do not sink below the surface unless compelled. They are truncated spheres, flat above with a loose outer envelope. A count of the ova deposited by three females in captivity revealed 514, 530, and 626 ova, or a mean of 557. Examination with a microscope disclosed the presence of three gelatinous envelopes, the inner envelope being .80 mm., the middle .27 mm., and the outer 1.08 mm., (Fig. 1). The vitellus is dark brown and light tan, about 1.35 mm., in diameter. Embryonic development from fertilisation to hatching takes approximately seventy-two hours at a temperature maintained at 77° F. +3° (25° C.).

LARVAL DEVELOPMENT

On hatching the tadpoles are a uniform pale brown in colour with the exception of the ventral surface and fin membranes which are translucent. Within forty hours of hatching the external gills, which are small and only clearly visible from the ventral view with the aid of a lens, are absorbed and the spiracle can be seen as an opening just forward of the anus in the mid-ventral line.

By the twenty-fifth day of development the tadpoles are approximately 21 mm. in length, pigmentation has become more intense and changed from a pale brown to a dark grey-black throughout the dorsal surface of the body and tail musculature and lightly spread across the tail crests except for a narrow translucent border which is comparatively free from melanophores. The heart and intestines can be seen through the abdominal wall.

Within the following ten days the hindlimbs and toes are well developed in the majority of tadpoles, the measurements being as follows: Body length 10 mm., tail length 20.5 mm., total length 30.5 mm., tail width 5 mm. The head and body is oval, one and a half times as long as broad. The mouth is dorso-terminal without horny mandibles and the lips without horny teeth or papillae (Fig. 2). The nostrils are slightly nearer to the tip of the snout than to the eyes and the internarial width is equal to about one quarter the interorbital. The spiracle is a translucent tube extending backwards beyond the anus on the mid-ventral line (Fig. 3). The tail is lanceolate, with the crests of equal depth, the dorsal crest starting slightly aft of the ventral.

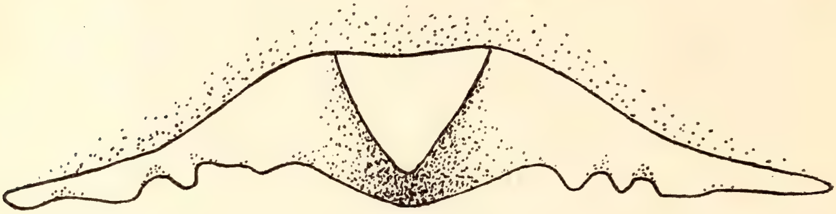


Fig. 2. Mouth parts of tadpole

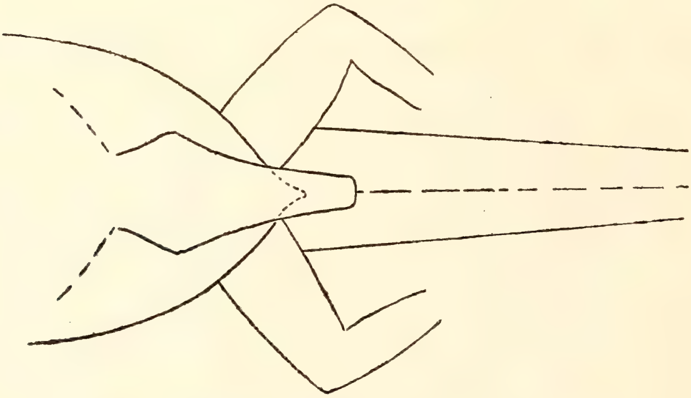


Fig. 3. Diagram of spiracle

Within the next ten days the forelimbs emerge and the coloration and markings on the body and limbs approximate very closely to those of the adult frog. The measurements of the tadpoles at this stage are: body length 9.5 mm., tail length 16 mm., total length 25.5 mm., tail width 2.5 mm., femur length 4 mm., and tibia length 3.75 mm.

In the majority of tadpoles metamorphosis is reached within the 50th to 60th day of development and the measurements of the young frogs at this stage are: length of head and body 9.5 mm., length of femur 4.25 mm., and length of tibia 4 mm.

Discussion on Larval Development

A very obvious observation recorded during this period was the considerable difference in sizes between larvae living under different conditions of food supply during corresponding stages of development. Under laboratory conditions, where food is unlimited, the tadpoles reach a length of as much as six millimetres in excess of their age counterparts living under more stringent conditions in the field. A comparison between the rate of growth of two batches of ova deposited on the same day, but one living under natural and the other under laboratory conditions, is given in Table I. Unfortunately all the tadpoles bred under laboratory conditions died before reaching metamorphosis. Apart from the increase in length of these tadpoles, their weight ratio was approximately 1.75:1 compared with their respective counterparts living in the field.

TABLE I

Rate of Growth of Tadpoles

Number of days.	Total length in mm. of tadpoles bred under	
	(a) Natural conditions.	(b) Laboratory conditions
5	5.0	7.5
10	10.0	12.0
15	14.0	16.5
20	17.5	20.0
25	21.0	23.5
30	25.0	27.5
35	28.0	32.0
40	30.0	35.0
45	25.5	31.5
50	20.0	Dead
55	9.5[1]	—
60	10.0	—
65	11.0	—

[1] *Metamorphosis*

Coloration

Unlike the highly variable colour schemes of many frogs and toads the pattern and colours of *Ramanella obscura* would appear to be very constant. The only noticeable colour-change recorded during two months of observation was a uniform darkening of the red-brown to blend with the black median markings and limb cross-bars. This change was more common and more pronounced in males than in females. The young frogs immediately after metamorphosis are a grey-black in colour. The characteristic red-brown coloration on the dorsal surface of the adult frog is not clearly present on juvenile specimens but the black and white patches and limb cross-bars are clearly noticeable. The blotched ventral surface of adult specimens is also clearly noticeable in juveniles.

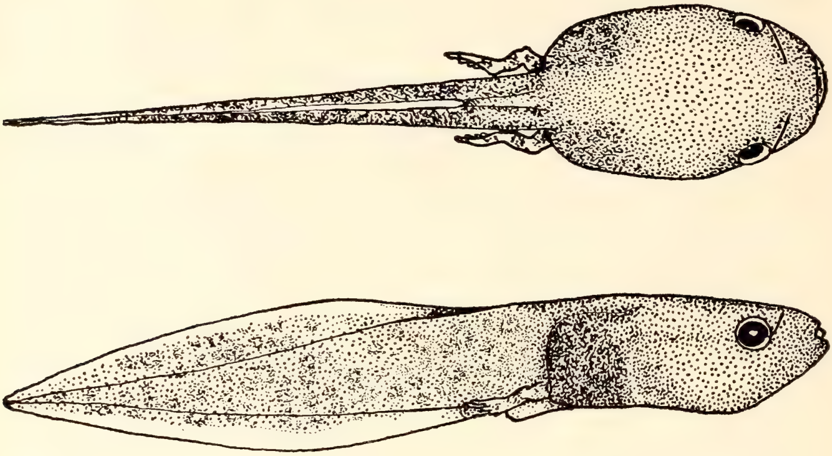


Fig. 4. Diagram of tadpole of *Ramanella obscura*

DERMAL SECRETION

The use of nauseous or poisonous dermal secretions as a means of protection from certain enemies is well known in the Anura. The first indication I had that *Ramanella obscura* possessed such an attribute was the excretion of a pale amber, highly adhesive, dermal secretion when the animal was being chloroformed. After a few seconds this secretion became so viscous that it became extremely hard to take it off one's fingers. Unfortunately I had no opportunity to test if this secretion is used as a means of defence. It may not be out of place to mention here that a similar dermal secretion, though somewhat of a slightly darker amber, is also found in *Uperodon systoma*.

ACKNOWLEDGEMENT

I am most grateful to Mr. P. Kirtisinghe, Reader in Zoology in the University of Ceylon, for his identification of this species and his valuable criticism and encouragement.

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Endemism and Outside Influence on the Flora of Manipur

BY

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INTRODUCTION

'The Sikkim type becomes established with the occurrence on the heights above the Irong of *Aucuba himalaica* a bush everywhere from the Laimatol range at 4,000 ft. to Saramati at 1,000 ft.' Thus observed Sir George Watt (1890) while writing about the forests of Manipur. Probably his remark was influenced by that of Clarke (1885) who considered that there is a striking dissimilarity between the floras of the Naga Hills and the Khasi Hills. Bor (1938) showed that the vegetations of the Khasi and the Naga Hills are not so dissimilar as considered by Clarke when comparable altitudes are studied, and any dissimilarity can be rationally explained as due to ecological factors. In this paper, the author analyses the floristic elements of Manipur with a view to examine the observation of Watt cited above.

SITUATION

The State of Manipur is situated between Assam and Burma. It lies between 23′ 47° & 25′ 41° E. and 93′ 6° & 94′ 48° N. Strategically the State is very important, constituting the eastern frontier of India and serving as a gateway to Burma. It is bounded on the north by the Naga Hills, on the south by the Chin Hills, Burma, and the Mizo (Lushai) Hills, on the east by the Somra tract and Upper Chindwin Districts (Kubbo Valley), and on the west by Cachar and the North Cachar Hills. The area of the State is 8638 sq. miles, about 700 sq. miles of which form the central valley of Manipur.

EXPLORATIONS OF MANIPUR

The first botanical exploration of Manipur was made by Watt who was deputed as botanist member to the Boundary Commission of 1881-82 set up by the Indian Government. He made some observations on the distribution of the flora and the influence of different elements on it.

Clarke traversed the same route as Watt and published in 1890 a list of 1050 species from Kohima and Manipur, of which only 422 were Manipur plants.

The next exploration of Manipur was undertaken by A. Meebold in 1906-7. He did not publish any account of his collections, nor did he keep any tabulation of them. Later, Anandale (1921), Biswas (1930), Bor (1938, 1945), Kingdon-Ward (1946-48), and Mukherjee (1946-48) explored the flora of Manipur from time to time, but none of them attempted to make any systematic study. Very recently Deb (1955) explored the flora during the years 1951-55.

NOTEWORTHY FEATURES OF MANIPUR FLORA

The floristic studies of Manipur by Deb (1955) reveal that the State contains 2191 species of higher plants ranging from Pteridophyta to Angiosperms, including 2 species new to science, 8 spp. new to India, more than 200 new records for the Assam region, and about 1500 new records for Manipur.

The new species are (1) *Hoya manipurensis* Deb (1955), and (2) *Gleadovia banerjiana* Deb (1957).

Of the eight species found to occur in Manipur as new records for India, one (*Viscum ovalifolium* DC.) has already been recorded by R. S. Rao of the Botanical Survey of India. Others are named below with the original home mentioned in parentheses. (Detailed descriptions with illustrations will be published elsewhere.):

(1) *Arundinaria kurzii* Gamble (South Burma), (2) *Bambusa kingii* Gamble (Upper Burma), (3) *Cycas siamensis* Miq. (Siam), (4) *Craibiodendron shanicum* W. W. Smith (Burma), (5) *Dicliptera riparia* Nees (Burma), (6) *Leucomeris decora* Kurz (Pegu), and (7) *Helicteres glabriuscula* Wall. (Burma).

SPECIES ENDEMIC TO MANIPUR

Of 2191 species found in Manipur, the following 27 species are endemic to this State ; with few exceptions, most of the other species occur also in the Assam region :

(1) *Arisaema wattii* Hook. f., (2) *Aster wattii* Clarke, (3) *Baliospermum meeboldii* Pax & Hoffm., (4) *Baliospermum suffruticosum* Pax & Hoffm., (5) *Begonia obversa* Clarke, (6) *Beaumontia longituba* Craib, (7) *Carex manipurensis* Clarke, (8) *Corylopsis manipurensis* Hemsl., (9) *Elatostema ciliatum* Clarke, (10) *Hedychium greenii* W. W. Smith, (11) *Illicium manipurensis* Watt, (12) *Iris bakeri* Wall., (13) *Iris wattii* Baker, (14) *Justicia anfractuosa* Clarke, (15) *Lilium mackliniae* Sealy, (16) *Passiflora assamica* Chakravarty, (17) *Pimpinella flaccida* Clarke, (18) *Phacellaria wattii*

Hook. f., (19) *Pilea minuta* Clarke, (20) *Piper gamblei* Clarke, (21) *Potentilla manipurensis* Watt, (22) *Rhododendron elliottii* Watt, (23) *Rhododendron johnstoneanum* Watt, (24) *Rhododendron manipurense* Balf., (25) *Rhododendron wattii* Cowan, (26) *Vernonia cylindriceps* Clarke, and (27) *Kalanchoe rosea* Clarke.

Only about 1.3% of the species are endemic to Manipur. These endemic species are mostly temperate and subalpine plants growing on hill tops. They are not generally found below 5,000 ft. in altitude.

SPECIES RESTRICTED TO THE KHASI HILLS AND MANIPUR

30 species hitherto thought to be endemic to the Khasi Hills are now recorded from Manipur, and this reduces the Khasi Hills endemics by that number.

They are as follows: (1) *Polygonum paleaceum* Wall., (2) *Polygonum rude* Meissn., (3) *Desmodium racemosum* DC., (4) *Desmodium griffithianum* Benth., (5) *Desmodium debile* Baker, (6) *Hydrobryum griffithii* Tul., (7) *Rubus opulifolium* Benth., (8) *Adina griffithii* Hasiland, (9) *Pavetta subspicata* Hook. f. (Jaintia Hills also), (10) *Psychotria symplicifolia* Kurz, (11) *Dipsacus asper* Wall., (12). *Begonia thomsonii* A.DC., (13) *Phyllanthus griffithii* Muell., (14) *Aeschynanthus superba* Clarke, (15) *Chirita brevipes* Clarke, (16) *Trichodesma khasianum* Clarke, (17) *Callicarpa psilocalyx* Clarke, (18) *Ligustrum myrsinites* Decne., (19) *Gelsimum elegans* Benth., (20) *Gentiana campanulacea* Wall., (21) *Trachelospermum articulatum* Schm., (22) *Gongronema ventricosum* Hook. f., (23) *Aechmanthera leiosperma* Clarke, (24) *Ebermaiera staurogyne* Nees, (25) *Justicia khasiana* Clarke, (26) *Strobilanthes maculatus* Nees, (27) *Ainslea angustifolia* Hook. f. & T., (28) *Senecio linifolius* Clarke, (29) *Arisaema petiolulatum* Hook. f., and (30) *Pogonantherum rufobarbatum* Griff.

SPECIES RESTRICTED TO ASSAM DISTRICTS INCLUDING MANIPUR

There are 21 species which are of restricted distribution to different districts of Assam but their range of distribution extends to Manipur also :

(1) *Indigofera anil* Linn., (2) *Bauhinia tenuiflora* Watt ex Clarke, (3) *Prunus jenkinsii* Hook. f. & T., (4) *Rubus assamensis* Focke, (5) *Rubus burkillii* Rolfe (Abor Hills), (6) *Rubus lucens* Focke, (7) *Piper muneyporence* DC., (8) *Cinnamomum pauciflorum* Nees, (9) *Polysolenia wallichii* Hook. f., (10) *Elaeagnus pyriformis* Hook. f., (11) *Aralia thomsonii* Seem., (12) *Anplectrum assamicum* Clarke, (13) *Eryngium foetidum* Linn., (14) *Ardisia khasiana* Clarke, (15) *Ardisia virens* Kurz, (16) *Rhyncotechum alternifolium* Clarke, (17) *Solanum kurzii* Br., (18) *Stichoneuron membranaceum* Hook. f., (19) *Lepistemon wallichii* Chois., (20) *Scutellaria khasiana* Clarke, and (21) *Hyparrhenia griffithii* Bor.

SPECIES RESTRICTED TO MANIPUR AND THE NAGA HILLS

(1) *Uraria clarkei* Gagnep., (2) *Helwingia lanceolata* Watt, (3) *Jasminum dumicolum* W. W. Smith, (4) *Senecio nagensium* Clarke, and (5) *Senecio rhabdos* Clarke.

SPECIES RESTRICTED TO THE KHASI HILLS, THE NAGA HILLS, AND MANIPUR

(1) *Ardisia polycephala* Wall., (2) *Strobilanthes acrocephalus* T. Anders., (3) *Pollinia pentasperma* Clarke, (4) *Smilax myrtillus* A. DC., (5) *Cymbopogon khasianus* Stapf, (6) *Brachiaria villosa* A. Camus, and (7) *Hierochloe clarkei* Hook. f.

SPECIES RESTRICTED TO THE MISHMI HILLS AND MANIPUR

(1) *Oxyspora cernua* Triana (Chittagong also), (2) *Callicarpa lasiocarpus* Clarke, (3) *Viburnum atrocyaneum* Clarke (Sikkim and the Naga Hills also), and (4) *Sapria himalayana* Griff. (The Aka Hills & the Khasi Hills also).

SPECIES RESTRICTED TO CACHAR AND MANIPUR

(1) *Ardisia keenanii* Clarke, and (2) *Parameria pedunculosa* Benth.

SPECIES RESTRICTED TO THE SIKKIM HIMALAYAS AND MANIPUR

(1) *Pimpinella sikkimensis* Clarke, (2) *Maesa rugosa* Clarke, (3) *Primula listeri* King, (4) *Ophiopogon clarkei* Hook. f., (5) *Globba hookeri* Clarke (the Naga Hills also), (6) *Tupistra wattii* Hook. f., and (7) *Cephalostachyum latifolium* Munro.

FINDINGS

From the above mentioned restricted influences of different categories the following points are elucidated :

(1) Only seven species endemic to the Sikkim Himalayas are found to occur in Manipur, a place outside their home. Other Sikkim plants recorded from Manipur are found in different parts of Assam as well.

(2) About 69 species endemic to Assam in general are recorded from Manipur.

(3) About 30 species, long regarded as endemic to the Khasi Hills, are found to occur commonly in Manipur only, outside their natural home.

(4) With these discoveries from Manipur, the number of endemic plants of Assam is reduced by about 69 species, and that of the Sikkim Himalayas by seven; these discoveries on the other hand indicate a greater phytogeographical affinity of Manipur with the Khasi Hills than with the Sikkim Himalayas.

(5) Only about 27 species are truly endemic in Manipur. Such a low percentage (1.3%) of endemics in this State may be accounted for, when we consider the geological history and geographical position of this area. Kingdon-Ward (1949) explains it lucidly thus : ' In fact the position of Manipur in the middle of glaciated mountains and astride one of the glacial escape routes was peculiarly favourable for receiving contributions of flora from all directions.'

CONCLUSIONS

In the light of the above findings, the observation of Watt may be left alone and we may safely conclude that Manipur forms a phytogeographical part of Assam, with a very high percentage of Indo-Malayan species and an admixture of some Sikkim Himalayan, Burmese, Siamese, and Chinese species.

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Observations on some Myxophyceae from High Altitudes

BY

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(*With five figures*)

INTRODUCTION

The present communication deals with 12 forms of Blue-green Algae, collected by Dr. M. S. Randhawa from Binsar and Gananath at an altitude of 6,000-7,000 feet above sea-level and from Dhakuri on the Pindari Glacier route in Almora District in Himalayas at an altitude of 8,500 feet above sea-level during 1938. In general, it is observed that the sheath in most of the members is very thick, probably a necessary consequence of the cold climate in these places, and the heterocysts are also very scanty in occurrence, as compared with the same forms occurring in the plains.

SYSTEMATIC LIST

1. **Aphanocapsa pulchra** (Kütz) Rabh. Geitler und Pascher, Süsswasserflora Deutschlands, Heft. 12, p. 65, 1925.

Colonies ovate or globose ; cells spherical ; loosely distributed within a copious mucilage ; contents blue-green.

Diameter of the cells, 3.8-5.7 μ.

Habitat : Among other algae on dripping rocks, Almora, June 1938.

2. **Chaemosiphon subglobosus** (Rostaf.) Lemm. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 428, fig. 247, 1930.

Cells globose to elliptical ; sporangium single-celled ; spherical or slightly elliptical (Fig. 4).

Diameter of the cells, 3.8 μ.

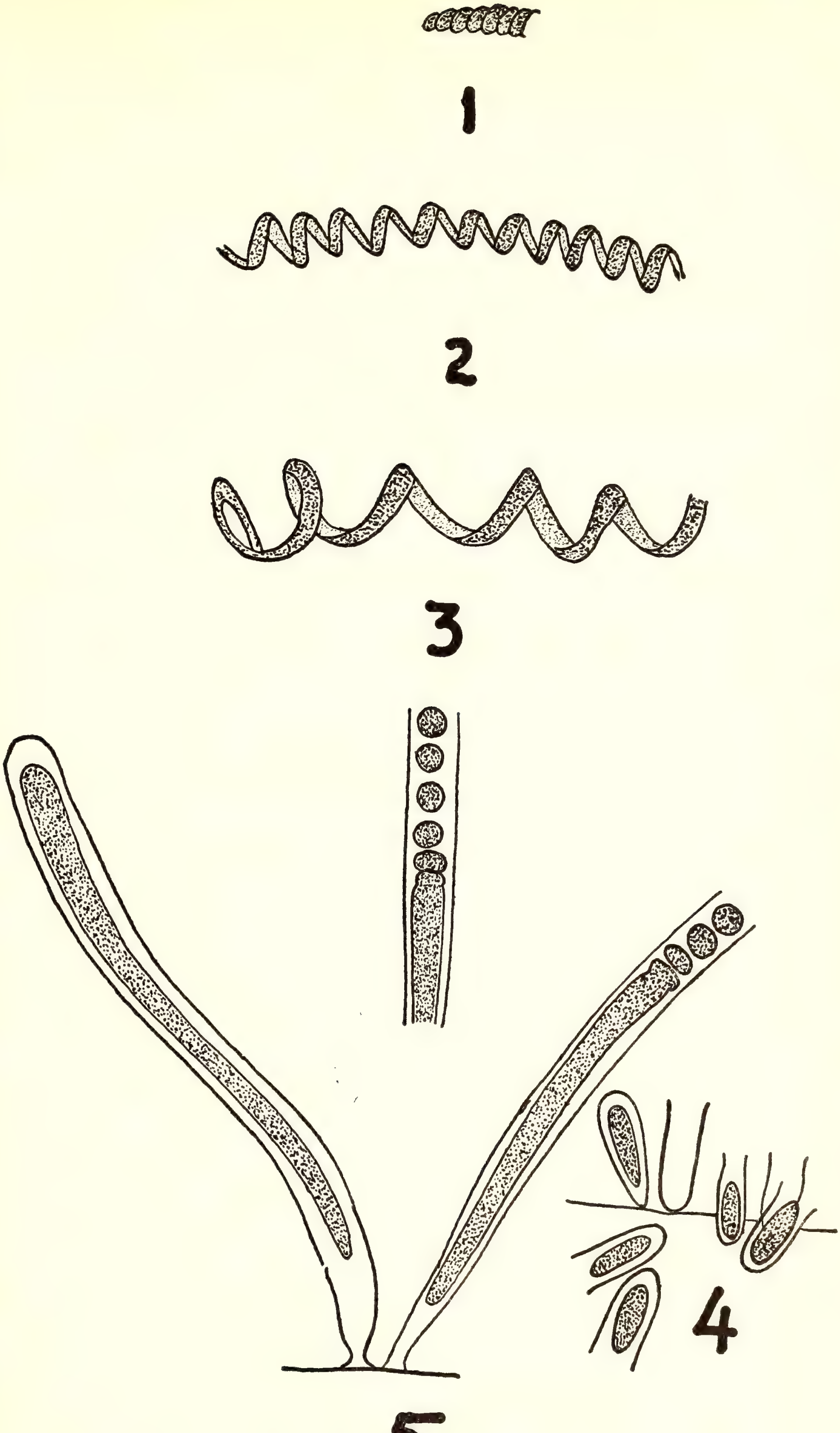
Length of the sporangium, 5.7 μ.

Habitat ; Epiphytic on *Scytonema ocellatum*, Dhakuri on Pindari Glacier route, Almora District, July 1938.

3. **Chaemosiphon curvatus** Geitler. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 426, figs. 244-6, 1930.

Solitary or gregarious ; cylindrical, curved ; sometimes club-shaped (Fig. 5).

Diameter of the cells 3.8 μ.



HIGH ALTITUDE MYXOPHYCEAE

1. *Spirulina nordstedtii* Gom. 2. *Spirulina laxa* Smith. 3. *Spirulina subsalsa* Oersted. 4. *Chaemosiphon subglobosus* (Rostaf.) Lemm. 5. *Chaemosiphon curvatus* Geitler. x680.

Length of the cells, 22.8-64 μ.

Habitat : Epiphytic on *Scytonema ocellatum* along with *Chaemosiphon subglobosus*, Dhakuri on Pindari Glacier route, Almora District, July 1938.

4. Spirulina nordstedtii Gom. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 930, 1930.

Trichomes closely and regularly spiralled ; cell contents blue-green (Fig. 1).

Breadth of the trichome, 1.9 μ.

Distance between the spirals, 5.7 μ.

Habitat : Along with *Scytonema* sp., *Spirulina laxa*, and *Spirulina subsalsa* on cowdung, Lokarkhet, Almora District, June 1938.

5. Spirulina laxa G. M. Smith. Geitler und Pascher, Süsswasserflora Deutschlands, Heft 12, p. 347, 1925.

Trichomes loosely spiralled ; cell contents blue-green (Fig. 2).

Breadth of the trichome, 1.9-2.8 μ.

Breadth of the spiral, 3.8-7.6 μ.

Distance between the spirals, 12.3 μ.

Habitat : On cowdung with *Spirulina nordstedtii*, Lokarkhet, Almora District, June 1938.

6. Spirulina subsalsa Oersted. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 927, fig. 593, 1930.

Trichomes loosely spiralled, sometimes closely spiralled. In closely spiralled portions the spirals are so close that there is no space between the turns ; cells blue-green (Fig. 3).

Breadth of the trichome, 1.9-2.8 μ.

Breadth of the spiral, 3.8-5.7 μ.

Habitat : On cowdung, along with *Spirulina nordstedtii* and *Spirulina laxa*, Lokarkhet, Almora District, June 1938.

7. Oscillatoria ornata Kütz. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 945, 1930.

Trichomes straight ; not attenuated towards the apices ; end cell rounded ; contents blue-green with fine granulations.

Breadth of the trichome, 4.7-5.7 μ.

Habitat : On stones from the bed of Kosi River, Almora, July 1938.

8. Oscillatoria proboscida Gom. Geitler, Rabenhorsts Kryptogammenflora, Bd. XIV, p. 943, fig. 598b, 1930.

Breadth of the trichomes, 12.3-14.4 μ.

Length of the cells, 3.8-4.7 μ.
Habitat : On stones in the bed of Kosi River, Almora, July 1938.

9. **Oscillatoria quadripunctulata** Brühl et Biswas var. **unigranulata** Singh. Singh, *Proc. Indian Acad. Sci.*, Vol. 9, p. 68, fig. 1F, 1939.

Trichomes straight, with a single granule on either side of the cross-wall.
Breadth of the trichome, 1.9 μ.
Habitat : On the boulders, along with *O. ornata* in the bed of the Kosi River, Almora, June 1938.

10. **Lyngbya epiphytica** Hieron. Geitler und Pascher, Süsswasserflora Deutschlands, Heft 12, p. 397, 1935.

Breadth of the filaments, 1.9-2.8 μ.
Length of the cell, 1.9-2.8 μ.
Habitat : Epiphytic on larger algae, Almora, July 1938.

11. **Scytonema ocellatum** Lyng. Geitler und Pascher, Süsswasserflora Deutschlands, Heft 12, p. 272, 1925.

Sheath thick ; yellowish brown ; contents olive-green ; heterocysts squarish and rare.
Breadth of the filaments, 11.4-19 μ
Breadth of the cells, 7.6-9.5 μ.
Length of the cells, 3.8-7.6 μ.
Habitat : On moist rocks, Dhakuri on Pindari Glacier route, Almora District, July 1938.

12. **Nostoc** sp.

Tough brownish balls ; trichomes highly contorted inside a confluent sheath ; cells blue-green ; spherical ; heterocysts intercalary ; bigger than the cells. Since no akinetes were observed, the identification of the species has been rendered impossible.
Breadth of the cells, 3.8 μ.
Breadth of the heterocysts, 5.7 μ.
Habitat : On dripping rocks, Almora, June 1938.

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I am highly thankful to Dr. M. S. Randhawa, D.Sc., I.C.S., for so kindly placing his valuable collections at my disposal and for his keen interest throughout the investigation. My sincere thanks are also due to

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Reviews

1. THE MONKEY BOOK. By Ernest P. Walker. Pp. 153 (26½ cm.×18 cm.). 51 black-and-white plates. New York, 1954. The Macmillan Company. Price ?.

This small book serves a useful purpose in giving expert advice and guidance in keeping monkeys both in the home as pets and in zoos. The author was for many years the Assistant Director of the National Zoological Park, Smithsonian Institution, Washington, and seems eminently fitted for this work. Genuine love and a sensitive understanding of animals is evident throughout the book and is typified by a paragraph on page 4 which deserves to be quoted for its wisdom:

'The extent to which a pet may be enjoyed probably depends more upon the person than upon the pet. If the person is very kind, gentle, and considerate, the pet will almost invariably respond and be a highly enjoyable companion. On the other hand, if one is determined to subjugate the animal and make it conform to human standards and become a poor copy of a person, the animal will lose its peculiarly fascinating personality for which it is charming, and is likely to be sullen, morose, antagonistic, and in general unsatisfactory.'

Keeping a monkey in the home, specially the less common or larger breeds, we learn is an exacting hobby entailing a great deal of sacrifice in money, time, living space, and home comforts. Feeding is not a simple business. Our knowledge of the dietary needs of the various species is still very sketchy and suitable menus have to be ascertained by intelligent trial. If the monkey in the wild eats a great variety of food, the elements thus obtained have to be made up by offering it a wide choice depending on its age and habits in the wild. The relish with which the animal accepts the various items indicates its dietary needs. In order to avoid deficiencies a remarkably wide range of foods, both cooked and uncooked, are recommended, some that most humans would consider unobtainable luxuries and many that no monkey in the wild has ever heard of. Thus we have items like ice cream, baked custard, cottage cheese, peaches, pears, and apricots at one end of the range, descending through boiled and raw vegetables, nuts, roast meat, eggs, various cereals, and bread to meal worms, grasshoppers, crickets, and spiders. This diet in judicious quantities has to be fortified with assorted vitamins and, for the young, the latest in baby feeds. Incidentally a human foster mother is recommended for newly captured baby Gorillas while in the jungle and then the care and advice of a child specialist. The recommendation at first sight is startling but on considerations of biological kinship quite obvious.

The author is firmly convinced that for keeping primates in captivity the 'solution of the psychological problem of keeping them happy is of even more importance than that of supplying them with food. If they become very unhappy they will not eat no matter what food you give them.' Consequently the book emphasises the need for giving the monkey, which is a gregarious animal, constant companionship either human or of other animals. Its need of participation in activity must be satisfied and the cage should be situated so that the monkey at least will have the benefit of the mental stimulus excited by seeing activity about it.

Practical directions are given for rigging up cages and living space suitably furnished for different species, with recommendations for optimum heating, lighting, and recreational arrangements. Provisions for the health, comfort, and well-being both physical and mental of the animal are thought out in meticulous detail with the loving foresight of a devoted and doting spinster aunt. Nothing seems to be too good for the pet. 'The pet is always right' (p. 24) is the motto adopted by the master.

It is interesting to learn from the chapter on Health (p. 20) that monkeys are also similar to humans in their ailments. They have internal parasites and diseases that do not seem to do much harm in the wild but in captivity they become serious enough to endanger the health of humans. Precautionary treatment is therefore advised, for instance against amoebic dysentery which is about one hundred per cent prevalent in rhesus and some of the other macaques (p. 21).

Part II of the book is given over to a catalogue of over 50 genera of both Old and New World primates. Two pages are devoted to each genus, one page illustrating a representative species and a descriptive page giving physical characteristics, range, and habits both in the wild and in captivity. The illustrations which are well chosen and beautifully reproduced add to the value of the book.

D. J. PANDAY

2. 'I NAME THIS PARROT . . .' By Arthur A. Prestwich. Pp. 86 ($21\frac{1}{2}$ cm. × 14 cm.). London, 1958. Arthur A. Prestwich, 61 Chase Road, Oakwood. 5*s*. 6*d*.

This is rather an extraordinary book and its interest must be somewhat circumscribed in that it consists only of a list of Psittaciformes which have been named after people, each followed by a short biography of the person concerned. If, therefore, you see the name *Neopsittacus musschenbroekii* and wish to know something about M. Musschenbroek, all you have to do is to look up the alphabetical list and you will find a neatly presented précis of his biography.

About the parrots so named there is little or no information to be discovered, but the list of people so honoured is amazing. They range from obscure politicians in the Seychelles to crowned heads of Europe, Alexander the Great, and a nephew of Napoleon Bonaparte. Many of them are of course rightly named after their discoverers or other distinguished naturalists. The book lists one Nicolas Thomas Marion du Fresne (1729-?) who was not a naturalist. His sole claim to fame is that he was given charge of an expedition to discover whether or not a continent existed in the Southern Ocean. Almost immediately after leaving his port of embarkation, his two ships collided with each other causing him to abandon the search! Another, *Psittacula calthorpae*, was named by Layard after his first wife.

As stated in the Preface, the compilation of this work must have entailed 'endless trouble in tracing innumerable obscure references'. It will no doubt be of assistance to anybody requiring such information.

N. J. NORTHOVER

3. SEAL MORNING. By Rowena Farre. Pp. 178 (21.5 cm.× 13.5 cm.). Hutchinson, London, 1957. 15*s*. net.

At the age of ten Rowena Farre was taken by her aunt Miriam to live in a lonely croft in the county of Sutherland in the extreme north of Scotland. Here they spent seven years in a waste of moor, bog, and water where trees were a rarity. Their nearest neighbour, a shepherd, lived four miles away, and for medical help and stores they had to walk or drive by trap to the *clachan* (village) about nine miles away. During the winter they were completely cut off from the outside world from mid-September to April or May, and their only companions were their animals, a really heterogeneous collection.

Arriving with Rodney, a Brown Rat (*Rattus norvegicus*), and two grey squirrels, Cuthbert and Sara, they quickly acquired a reputation as animal lovers which brought them the gift of two otter cubs. The otters Hansel and Gretel flourished and soon learnt to forage for themselves. In the following June Rowena returned from a holiday in the Outer Hebrides bringing a young Common Seal, Lora, who quickly established herself as a prominent member of the family. Other members were a pony, two milch goats, and a yellow mongrel dog Ben. This leaves out of account several pets which spent a comparatively short time at the croft.

With the opportunities which this life placed in her way Miss Farre, who combines her love for animals and genuine knack for handling them with a gift for observation and a light discursive style for recounting her observations, tells us much to interest lovers of nature.

The hero is undoubtedly Lora who has given the book its name. Her accomplishments are too many to be mentioned in a short review. One of them was music. At an early age she responded to the piano and learnt to sing to the accompaniment of a mouth organ. Later she persuaded the young Rowena to surrender the mouth organ to her and soon was playing simple tunes on it. Admiring visitors presented her with other musical instruments. In due course she attended a *ceilidh* (musical evening) and readers will enjoy Miss Farre's account of how she took possession of the platform to the exclusion of the other performers. Lora accepted with complacency all the other pets but at once showed signs of jealousy when Miss Farre came back from another holiday with Bernie, a baby Atlantic Seal. Seizing an early opportunity of attacking him, she inflicted injuries which caused his death.

Miss Farre gives particulars of an interesting test of the intelligence of her pets. The criterion was the number of words to which each was able to attach a definite meaning. The figures were Lora 35, the female otter 18, the male otter 16, Ben the dog 12, Rodney the rat 6, and the squirrels 5.

I cite Miss Farre's description of the relations between Rodney and the two squirrels: 'Presumably Rodney, as there was no female rat around, looked to Sara for companionship. ... It was interesting to note the various moves and sounds which this male rat made in order to lure the female squirrel into his box. Perhaps Cuthbert would be in the basket, Rodney in his box, and Sara on the carpet or perched on a ledge of the dresser. A soft chitter from Cuthbert would inform her that her presence was required in the basket. She would start towards it and then, to her bewilderment, would come a low, drawn-out squeak from the box by the dresser; a very different sort of squeak from the kind Cuthbert was treated to. Sara would turn, undecided. Another low, come-hither squeak, and the sight of Rodney sitting up in his box would have her hurrying to him. Then there would come a more commanding chitter from the basket and perhaps Cuthbert would emerge, his tail flickering. If Sara should happen to enter the box he would leap from the basket on to a chair, spring down and streak across the carpet. In order to avoid quite an unpleasant little set-to I would pick Sara up and put her in the basket.' Ultimately Cuthbert was carried away by a peregrine falcon, and Sara adopted Rodney's box as her home.

These are samples of much that the reader will enjoy in this thoroughly readable book, which deals with other subjects besides animals and their doings.

The book is neatly got up and is illustrated with attractive drawings by Raymond Sheppard.

D. E. R.

4. LES CHAMPIGNONS D'EUROPE. Par Roger Heim. Tome I, Pp. 327 (19 cm. × 14 cm.). 56 plates in colour, 20 plates in black-and-white photos, and numerous text figures. Tome II, Pp, 572 (19 cm. × 14 cm.). 52 plates in colour and 625 drawings. Paris 1957, Editions N. Boubée and Cie. Price ?.

Mycologists, both professional and amateur, will be grateful to M. Roger Heim and his publishers for this superbly produced and excellently illustrated work on the European mushrooms and toadstools. In a fluid and pleasing French, the first volume discusses many aspects of the biology of the Fungi. The range of this vast group is considered and the introductory chapters are devoted to biological problems peculiar to the group. Here the simpler and more primitive Fungi are briefly described and related to those more advanced forms that hold the central place in the later discussions.

In Chapter one M. Heim differentiates the Fungi from both the plant and the animal kingdoms, and the evolution of the group is considered with some especial attention to the occurrence of regression. The second chapter is devoted to the general ecology of the higher Fungi, Ascomycetes and Basidiomycetes, the influence of climate, soil character, and biotic factors being discussed in turn. In Chapter three the anatomical form of the vegetative and reproductive bodies is described, while in Chapter four precise details of microscopic anatomy and the techniques useful in examining specimens may be found. Coloration and pigment composition and the value of characteristic pigments in determining taxonomic relationships is discussed in Chapter five. M. Heim then turns to a most exciting field, poisonous toadstools. Various types of illness are described and the mechanism whereby each malady is brought about made as clear as present knowledge permits. The volume ends with diverting contributions to mushroom culture and the delightful properties of Fungi when prepared for the table. M. Heim suggests recipés that will make any reader's mouth water—'Pochouse aux petits rosés de Hautecombe', 'Lactaires delicieux grillés à la Lucefer', and 'Poulet aux delices des poètes' are surely dishes at which any enterprising amateur chef will want to try his hand. The concluding parts of Volume I and the whole of Volume II are devoted to a description of the European mushoom and toadstool flora. A number of novel features are introduced here so that complex keys, so often the curse of all except the very expert, are avoided and even the most amateur of dining table collectors need have no fear in attempting to identify a specimen. The careful and painstaking layout of this descriptive section, together with the many admirable text figures, will make this study a standard reference book in Europe for many years. An excellent series of black and white photographs, documented with clear and concise legends, and a large number of beautiful colour plates complete a work that botanists, 'mycogastronomists,' and naturalists will find a constant source of interest and attraction upon their shelves.

John H. Crook

5. WILDFOWL OF THE BRITISH ISLES. By Peter Scott and Hugh Boyd. Pp. 64 (24.5×15.5 cm.). With 16 coloured plates. London, 1957. Country Life Limited. Price 21*s*. net.

This book is one of sheer enjoyment to any ornithologist or wildfowler for many of the birds are common migrants to India and the descriptions of what occurs as it were at the other end of the world cannot fail to arouse interest.

Combine a first class ornithologist and descriptive writer and broadcaster with a world famous painter of wildfowl and you have Peter Scott, one of the authors of this book. The other author is Hugh Boyd, an eminent biologist. Consequently, it is not only an informative book but it is also, because of its illustrations, a beautiful book.

The tone is set by the frontispiece which is the only illustration not directly connected with the text—it is a reproduction of a nostalgic Scott painting, 'Mallards Dropping in'.

Turning away from the illustrations over which I have perhaps lingered too long, the text is divided into three main parts, Swans, Geese, and Ducks. At the end there are some short notes on unidentifiable wildfowl and an appeal to readers to report ringed birds, together with a guide to connected literature and a selected bibliography.

There is not much point in my commenting here on the descriptions of any of the individual birds given in the work, for to do justice to them one would have to quote an example verbatim—better, read the book! However, some of the difficulties of identifying wildfowl should perhaps be mentioned for, as the authors point out, in Britain this is not only complicated by the normal impediments of dull lighting, birds too far off or too brief a glimpse, compounded by over-optimistic and unerudite observers, but in addition the birds themselves deceive. The birds do this by escaping unfairly far afield from their normal habitats from zoos and other private collections, wherein to make matters worse they may hybridize with other species of not normally contiguous habitat in the wild.

For this nuisance the authors particularly condemn the Muscovy Duck about whom they say: 'Nearly all large black or white or black and white ducks with knobbly looking reddish bills fall into this class—especially when seen sitting on roof tops'.

Frequently it is impossible to determine whether a specimen is a bona fide foreign visitor or an unmarked escapee from a near-by local collection. This has for instance extended the breeding range of certain species such as the Gadwall.

N. J. NORTHOVER

6. THE PET-KEEPER'S MANUAL. By Eric Fitch Daglish. Pp. xi+178 (21.5×14 cm.). With 16 pages of photographs and many drawings. London, 1958. J. M. Dent and Sons Ltd. Price 18*s*. net.

This book is written for the pet-keepers of Britain but will be of interest to pet-keepers and naturalists anywhere for it is an extremely comprehensive, lavishly illustrated, well written and well produced treatise on the subject.

The primary object, of course, is to tell how any given pet should be maintained in captivity. However, the book does very much more than that, for it includes very good descriptions of the animals' habits in the wild.

The Indian fauna is well represented including the Malabar and the Striped or Palm Squirrels, the Mongoose, the Indian Fruit Bat, the Chameleon and the Rock Python, and Turtles, Tortoises, Bulbuls, and Mynas.

Of these last the author says that the Greater Hill Myna is the easiest to teach to talk, being a better mimic and more intelligent than its relations.

On the subject of snakes he says that the main difficulty encountered in their keeping is getting them to feed, particularly those that insist on live prey which may be unobtainable. His method of overcoming this seeming impasse is force-feeding, which has to be carefully done to avoid damaging the snake's lips or mouth. He advocates filling with food a glass tube of suitable size, or in the case of larger snakes a rubber tube, and then with the aid of an assistant or two, depending on the size of snake, sliding the tube down the throat to a length of several inches. When in the required position, the food is gently ram-rodded from the tube into the snake. When empty the tube is slowly withdrawn and the snake massaged to ease the food toward its stomach. The whole operation if carefully and efficiently done does not harm the snake and takes very little time. Where the content of the tube cannot be dead natural prey, then for *all* snakes he recommends minced raw lean beef with a few drops of Cod liver or Halibut oil and an odd lump of fur or feathers to provide the necessary roughage. I imagine that in India, where the snake could be provided with sufficient sunshine, the Cod liver oil would not be necessary.

Snakes about to slough should not be fed at all but merely provided with some stones or twigs to assist them in scraping off their old skin.

All the hints on snakes are only for the non-venomous ones and I think it a pity that reference to the poisonous varieties is omitted. The only other group of pets likewise omitted is dogs about which he rightly says plenty has already been written elsewhere.

Information about all types of pets ranging from mice and parrots to baboons and Kinkajous can be found in this work which covers hundreds of the most diverse species.

N. J. NORTHOVER

7. NO TEARS FOR THE CROCODILE. By Paul L. Potous, Pp. 188 (21.5 cm. × 14.5 cm.). With 30 photographs and 1 map. London, Hutchinson, 1956. Price ?.

With several years' experience as a professional crocodile hunter in Africa in the Lake Nyasa region the author has much of interest to tell his readers.

The book begins with a life-history of the crocodile. The mother buries her eggs in the sand at a spot where the sun can warm them. Throughout the period of incubation, more than 70 days, she stands guard over the eggs. Enemies are numerous, particularly monitor lizards who enjoy indifferently a diet of crocodile eggs or young, and even a temporary absence may mean the loss of many precious eggs. Once the young ones hatch out and the mother has helped them to emerge from their shelter in the sand her responsibility towards her babies is ended and she departs. After this her children, each about 5 inches in length, have to look after themselves. Enemies abound and the little ones have to move with the greatest caution, feeding on small insects and their larvae and gradually, as they increase in size, going on to larger prey. At the end of five years a crocodile is about five feet long. After this growth is at the rate of an inch a year, so that a 14-foot crocodile is little over 100 years old. The sizes of crocodiles where Mr. Potous did his shooting do not run very high, the longest crocodile in his experience measuring only 16 feet 4 inches.

In spite of its dull and heavy appearance the crocodile, according to Mr. Potous, is a wary and intelligent opponent. It suns itself on sandbanks where it cannot be approached from behind and where it has a clear and uninterrupted view in front, and its senses of smell, hearing, and eye-sight which are 'exceptionally keen' make approach within certain shooting distance very difficult. They quickly become conscious of new dangers, and the hunter has continually to devise new methods of getting at them.

As a rule the crocodile does not attack unless it is at an advantage, and Mr. Potous speaks of it in consequence as a coward. In my opinion the epithet is not justified; creatures living in the wild in circumstances where perfect fitness is necessary for survival cannot afford to take avoidable risks. That crocodiles are not lacking in courage will appear from Mr. Potous's description of a charging crocodile: 'There were five crocodiles on the sandbar, and I was able to bag one of them. Three minutes later, as we were standing near the edge of the water, we noticed a large crocodile in the middle of the river a hundred yards upstream. It was acting in a most unusual manner, for normally they swim with only the tops of their heads and backs showing. This one was coming diagonally across the river at a great pace, with its head and upper part of its body well out of the water. The remarkable thing was that it had obviously seen us and was coming straight for the island. The boy immediately became excited, saying that it was the man-eater of which we had been warned. He was all for making a dash through the water back to the mainland, but I stopped him, for if the crocodile was actually coming for us it would be safer on land than in thigh-deep water. I still could not believe the crocodile meant business and I was interested to know how close it would approach. It was still coming towards us and we moved back from the water's edge. We could not go far as the island was very narrow and the highest point was not more than three feet above the water. When the crocodile was a few yards from the sand, it slowed down its pace, sinking lower into the water. By now the boy was thoroughly frightened and begged me to shoot. I was very tempted to do so, for it was an unpleasant situation as the crocodile seemed determined to attack us. As it reached the sand it crawled a few feet out of the water and stood looking at us with its mouth partly open. I was astounded that it should have left the water and as it was now no more than seven paces away, I shot it through the mouth, for a crocodile can move exceptionally fast over a short distance on land, and they are difficult to stop. I still regret having fired, for now I shall never know if the crocodile would have actually charged us on land. I can only think that this particular crocodile had on previous occasions put to flight so many unarmed natives that it had lost its fear of man. This experience leads me to believe that some of the astounding stories told by the natives of crocodiles chasing them on land are not entirely untrue'. Another such charge is described by Mr. Potous on a later page.

Mr. Potous does not believe the oft-repeated story about birds that obligingly clean the teeth of the crocodile. It is true that the movements of the Whitewinged Plovers that haunt the sandbanks and feed off the numerous blood-sucking leeches which cling to the skins of the reptiles warn the crocodiles of approaching danger, but in many years of stalking and watching Mr. Potous has never seen a bird enter the mouth of a crocodile. He adds: 'A further reason for disproving this long-standing fallacy is that the crocodile does not have scraps of food sticking between its teeth, for each tooth is widely separated from its neighbour both in the upper and lower jaws.'

Among tales which are not within his direct knowledge is one about which we would have liked some authentic details. It relates to an African villager who was carried away by a crocodile to its burrow in the river bank. Apparently the crocodile had recently feasted and did not immediately want a meal, and therefore the man managed to escape and get back to his village.

Mr. Potous does not confine himself to crocodiles. Among other animals he tells us about the monitor lizard *Varanus niloticus*. When in search of a crocodile's nest the monitor moves slowly forward tapping the sand with its forked tongue. The author tells us that it proceeds by echo sounding, and rarely makes the mistake of digging where there is no nest. Its tail affords it protection in two ways, firstly as a defensive weapon, and secondly as something to wave like a snake thus frightening away the observer. One monitor lizard within Mr. Potous's experience leaped down a sheer distance of 20 feet and landed with no apparent hurt to itself.

These are samples of the varied fare that awaits the reader.

D. E. R.

8. BIRD HYBRIDS: A Check-List with Bibliography. By Annie P. Gray. Pp. viii+390 (24.5×15.5 cm.). Commonwealth Agricultural Bureaux, Bucks, England. 1958. Price 50*s*. net.

Birds as a class are perhaps better known and studied than any other animals. Many species have been domesticated by man since ancient times, and play an important part in his food economy. Others are kept as pets for aesthetic reasons and selectively cross-bred to produce special strains for song or beauty, and birds are subjected to all kinds of scientific experimentation besides. The breeding of wild birds in captivity has furnished invaluable scientific data for genetical and evolutionary studies. Hybrids have been produced intentionally or through a fortuitous bringing together of different species from widely separated parts of the world in avicultural collections. But hybridization also occurs on a large scale under natural conditions between sympatric species as is shown by the fact that many Humming Birds and Birds of Paradise formerly recognized as distinct species, have been shown, on closer study, to be nothing but natural hybrids.

The superficial morphology of hybrids is often quite confusing. The confusion is increased by the fact that in many birds the young differ so markedly from their parents in appearance, and in others the sexual dimorphism is so great, that in the past young and old or male and female have sometimes been ascribed to different species, or to the result of hybridization. On the other hand natural hybrids have often been attributed to new species. Descriptions of known hybrids were widely scattered in the literature of many countries and languages, and references were difficult to find. Thus, to the serious aviculturist no less than to the taxonomer, the systematist, and the scientific field ornithologist the present compilation in a single volume of all the widely scattered, published as well as unpublished, reports of bird hybrids should prove invaluable. It gives a concise history of most of the crosses recorded and furnishes useful suggestive data which have an indirect bearing also on genetics, courtship patterns, and isolating mechanisms. The hybrids are grouped within Families and are arranged alphabetically under the scientific names of species involved. Under each species is given a full list of those with which it is said to have hybridized, or with which hybridization has been attempted.

Thus, under *Anas platyrhyncha* (the Wild Duck or Mallard)—the progenitor of our domestic duck—hybridization with no less than 50 species is recorded, some belonging to widely distinct genera, e.g. *Anser, Branta, Mergus.* The strangest report of all is of the hybridization of this duck with a Guineafowl; the authenticity of this seemingly impossible cross is, however, mentioned as 'extremely doubtful'. Natural hybrids among the Anseridae, particularly the ducks, are well-known, and a number of such have been shot in India by sportsmen from amongst the migratory species. Other groups of birds in which hybridization is common are the Pheasants (Phasianidae), Parrots (Psittacidae), Humming Birds (Trochilidae), Birds of Paradise (Paradisaeidae) and Finches (Fringillidae). This may doubtless be due, in part, to the fact that these groups constitute popular aviary birds which readily acclimatize themselves to captive or semi-feral conditions.

The comprehensive nature of BIRD HYBRIDS and the magnitude of the task of compiling it may be gauged from the voluminous bibliography which covers 78 pages and includes over 1900 titles. An index of scientific and vernacular names facilitates ready reference.

S. A.

Miscellaneous Notes

1. HABITS OF THE ASIATIC BLACK BEAR *SELENARCTOS THIBETANUS* G. CUVIER

In *JBNHS* **52** (2 and 3): 586, I contributed a short note on the above subject. In NO PASSPORT TO TIBET by Lt. Col. F. M. Bailey, Butler and Tanner Ltd., second edition, 1957 I find that Lt.-Col. Bailey also came across a bear nest in August 1913 at Shu, altitude 10,400 ft. (10 miles from Mipi). Below is an extract from page 166:

'At Shu we halted because Morshead wanted to take the latitude and an azimuth to set the compass. He wasn't fully successful, because in the afternoon the sky clouded over and then it came on to rain. I had gone up the ravine to look for specimens and by the time I returned I was drenched through. I was told that in summer there was no game but in winter there were serow, bharal, snow cock, eared pheasants, and another they called "kuling", which sounded from their description like some kind of jungle fowl.

'They were keen that I should shoot bears for them. The bears came down every night and ruined their crops. I saw many of their tracks and in a tree beside a field the bears had made two "nests" or lairs by bringing together the leafy branches to form platforms about three feet by two, so dense that I could not see through them. But the bears themselves were not to be seen, though I sat up in a tree for some time, hoping they would come.'

25 INYA MYAING ROAD,
UNIVERSITY P.O.,
RANGOON, BURMA,
March 31, 1958.

TUN YIN,
B.C.S. (S.G.), Retd.

2. A NOTE ON THE FLYING FOX (*PTEROPUS HYPOMELANUS MARIS*) OF ADDU ATOLL, MALDIVE ISLANDS

Two species of the large fruit-bat commonly called the Flying Fox occur in the Maldive Islands, the commoner form *Pteropus giganteus ariel* in all the more northerly atolls, and *Pteropus hypomelanus maris* in the south (Hill, 1958). They appear to be the only members of the order Chiroptera that inhabit this archipelago; no smaller fruit-bats or insectivorous forms (Microchiroptera) have been observed in any of the islands.

Pt. giganteus ariel is common in North Malé and throughout the majority of the atolls; *Pt. hypomelanus maris* is plentiful in the islands of the Addu Atoll in the extreme south of the archipelago, but how far north its range extends, where it meets *giganteus*, and whether the ranges of the two species tend to overlap are questions that have not yet been settled definitely. It is reported, nevertheless, that there are no flying foxes on Fua Mulaku Island, 30 miles or so to the north of Addu Atoll, but they are common again in Suvadiva Atoll, a further 30 miles or more to the northward of Fua Mulaku Island. It may well be that *maris* is confined to Addu Atoll and that the Equator is the dividing line between the ranges of the two species.

Having had the opportunity of studying the habits of *giganteus ariel* during a visit to Malé towards the end of 1956 and in early 1957 and those of *hypomelanus maris* while stationed in Gan, Addu Atoll, in 1958, the object of this paper is to give a short account of the habits of the latter species to show in what way it differs from those of *giganteus ariel.*

Before going any further, however, it should be noted that, although both species are exceptionally large bats and have the appearance of being of much the same size and colour on the wing, *hypomelanus maris* can readily be distinguished from *giganteus ariel* by the distinctive outline of the head when seen side-face; in *maris,* the muzzle appears much thicker and the face does not have the sharp-pointed look of *giganteus* but is rather blunt and gross. This distinguishing feature is readily noticeable even at a distance.

General habits: Contrary to the habits of the great majority of bats, *maris* is as much diurnal as nocturnal. At any time of the day, even at noon when the sun is overhead and at its hottest and brightest or when rain is beating down, these bats may be seen flying about and feeding on the villagers' pawpaws. On the other hand, others may be seen hanging from the underside of a coconut palm leaf or a shady branch, sleeping or fanning themselves lazily with their wings. It would seem, therefore, that they partake of food whenever they feel so inclined, without reference to the time of the day or the night, to the brightness of the sun or the darkness of the night. Presumably, as they appear to have no enemies (other than man to a very minor degree) there has been no necessity for them to maintain their nocturnal habits, but that they do still fly and feed by night as well as by day is proved by the fact that it is of frequent occurrence for one to collide at night with overhead electric cables and be electrocuted. They have not been observed to drink, unless they are doing so when they crawl into the crown of a coconut palm.

Although *giganteus* prefers to spend the day in communal roosts, no tendency to do so has been observed in *maris*. Whether flying from place to place, raiding the villagers' fruit trees, or resting and sleeping, *maris* is always solitary. Occasionally, two will meet while preparing to feed, whereupon a wrangling, screeching interlude ensues until one or the other takes its departure, but it is most exceptional to see more than one in the same tree. On the rare occasions when two have been observed hanging at rest within a few feet of one another, it has been thought that they were probably a paired ♂ and ♀.

Food: Although pawpaw is the most sought after fruit food, mangoes in their season, *jambu* and *jamburaulu* are all eaten avidly; plantains or bananas are consumed occasionally but are not in general favour, while wild figs from the few banyan trees (*Ficus* spp.) are readily devoured when ripening, and the berries of the wild *damba* trees are also taken. Generally speaking, however, these fruit bats rely upon the villagers' gardens for their sustenance and undoubtedly do a great deal of damage to the fruit crops. Curiously enough, the villagers find them helpful in connection with the tapping of the coconut palms for toddy; they state that the bats do no harm to the palms (they may indeed assist in the fertilisation of the flowers); on the contrary, when they visit the flowerstalks that have been tapped, they stimulate the flow of the juice by licking up the congealing drops and allowing a freer flow of sap.

Flight: The flight is typically deliberate and flapping, as in *giganteus*, but it is unusual to see *maris* flying high up; generally it flies about 100 ft. or less from the ground and often, when it has to cross open country or the sea, it will fly within a few feet of the surface, sometimes even taking advantage of the troughs of waves to shelter itself from the wind. On alighting in a palm or other tree, the head is held upwards and it grasps the objective with both feet and wing-claws; it then proceeds to clamber into position using its wing-claws and feet in a rather clumsy and awkward gait, encumbered by its membranes, until it can resume its accustomed head-down hanging attitude in its chosen place. When arriving to feed upon a pawpaw, the bat will hang up in the typical position if a suitable twig be handy; otherwise, head up and wings half extended, it will clasp the fruit to it and bite into it until it is satisfied or the fruit consumed. Then it will flap off to a nearby palm and hang from the underside of a midrib in a shady and airy spot until hunger urges it to raid another fruit tree. When in flight, the wing-claw is always held rigidly out in front of the wing.

Although an interesting animal from the naturalist's standpoint, there can be no question that *Pteropus hypomelanus maris* is a sore trial to the villagers of Addu Atoll.

c/o R. A. F. Gan,
B.F.P.O. 180,
Maldive Islands,
June 22, 1958.

W. W. A. PHILLIPS

References

Hill, J. E. (1958): Some Observations on the Fauna of the Maldive Islands. Part II—Mammals. *JBNHS* **55** (1): 3.

3. WILD ELEPHANTS IN THE UNION OF BURMA

(*Supplementary Note*)

Kheddah Operations

In December 1956 [*JBNHS* **54** (1): 177] I gave a statement of wild elephants captured in Burma from 1945-46 to 1951-52. Below is a statement of elephants captured from 1952-53 to 1956-57:

	Number captured	Number died, released, or escaped	Balance
1952-53			82
1953-54			78
1954-55	59	4	55
1955-56	98	13	85
1956-57	161	23	138

Destruction of Wild Elephants

The insurgents are reported to have shot a large number of tuskers for the ivory in the Arakan Yomas. The same thing has happened in the Kachin State, where a number of wild elephants were illicitly shot for the ivory by the hill tribes. The ivory is taken across to China for disposal.

25 Inya Myaing Road,
University P.O.,
Rangoon, Burma,
March 31, 1958.

TUN YIN,
B.C.S. (S.G.), Retd.

4. BHARATPUR 'WILD' CATTLE

(*With a plate*)

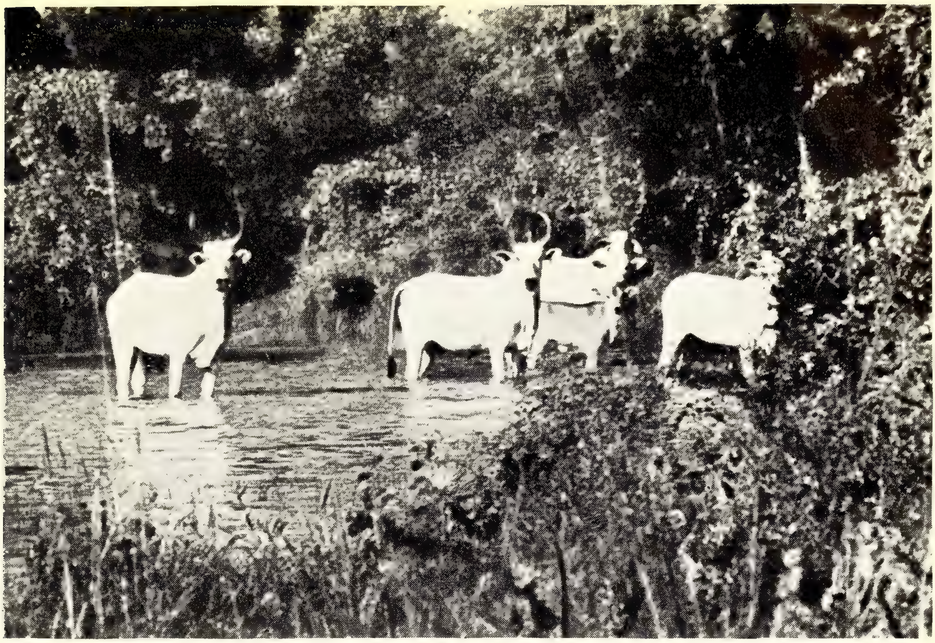
In September 1957 I had the good fortune to be at Bharatpur for a few days, where Sálim Ali and I were visiting the Keoladeo Ghana. In conversation one evening the Maharaja mentioned the existence of some 'wild' cattle in the neighbourhood, and when I showed great interest in these he very kindly offered to help me locate them. Two days later a jeep was taking Sálim Ali and me with a guide in search of these 'wild' or 'semi-wild' cattle.

We travelled some twelve miles along a pucca road and eventually reached a village called Hirak. A few miles further by rough village track, and thence another mile or two on foot through fairly thick scrub jungle flooded by the recent rain, and we crept silently up to a herd of these 'wild' oxen. As soon as they saw us they stared intently at us and then rushed away as a herd in semi-circular course, just as I have seen the Chillingham wild cattle do in Britain. We followed them up and again came across the herd, some of which can be seen in the accompanying photograph. Again they galloped away, and once again we caught a fleeting glimpse of them before we returned to the jeep and Bharatpur.

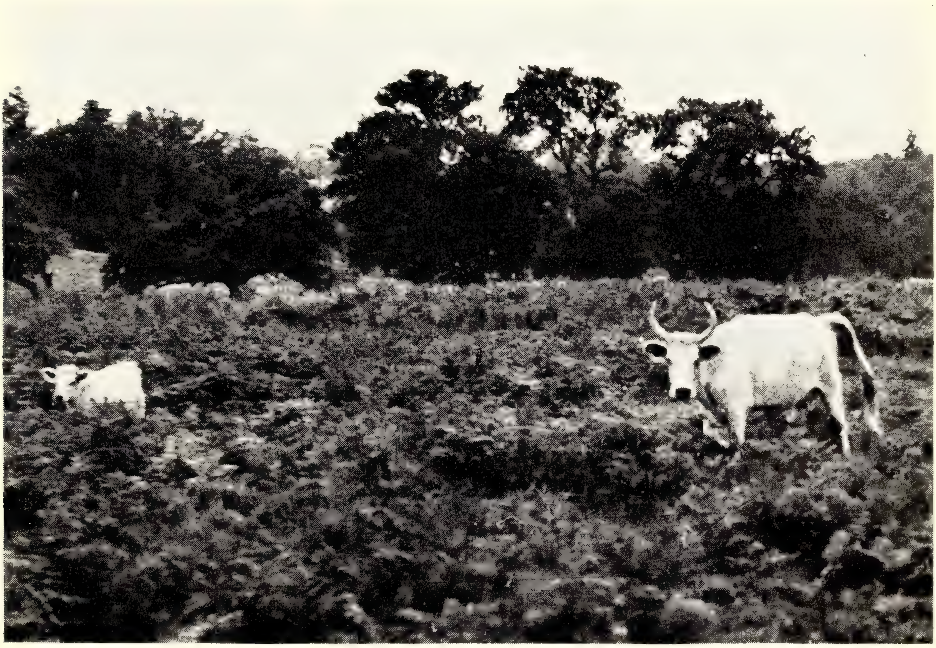
I was informed that these cattle are presumed to be ones which have long ago left the villages, and they now never return to human habitation. Totally feral, they cannot be approached closely, and lead an entirely wild life in the forest and open scrub country. How long this particular herd had been running wild I could not ascertain, but the animals certainly appeared to be living entirely aloof from human habitation and apart from domestic herds. They seemed to have developed the social and behavioural characteristics usually found in herds of gaur and other truly wild oxen. They have to fend for themselves against diseases and predators—wolves and hyenas.

I was particularly struck by their resemblance in behaviour, if not in appearance, to the Chillingham wild cattle which I had observed and photographed in Britain in 1950. I have been informed, however, that these 'wild' cattle of India are never aggressive to humans as are sometimes the Chillingham ones. It occurred to me that here was an excellent opportunity for local field naturalists and zoologists to study the habits and behaviour of these animals, to discover to what extent they resemble the gaur of Asia, the Chillingham wild cattle of Britain, or any other such bovines.

Almost certainly each herd of these 'wild' cattle would have a master bull, which would occasionally be challenged by a rival, and



Bharatpur 'Wild' Cattle. Part of the herd turned to gaze at us



Cow and calf of the Chillingham Wild Cattle in a remote part of Britain

Photos : E. P. Gee

sometimes be defeated in battle. A vanquished bull would either live apart, or else play a subservient role in the herd. Whether there are look-out bulls in a herd, to warn the others against any danger confronting them, is not known. Whether cows go away to calve in secret, returning to the herd later on with the young calf, is not known. Whether the strain is becoming purer and purer either by inbreeding true or else by elimination by killing of impure offspring, this and many other things need to be learnt by close observation and study.

Since seeing the Bharatpur 'wild' cattle, I have been informed that there are several other such 'wild' herds in Rajasthan, Uttar Pradesh, and Madhya Pradesh. Here, then, is an interesting field of study in several parts of India. Possibly some members of the Society or their friends may be able to throw more light on this subject. In the not too far distant future a decision may have to be made as to whether or not these 'wild' cattle of India are to receive some measure of protection (in addition to that derived from local religious sentiment) as part of the wild life heritage of the country.

DOYANG T. E.,
OATING P.O., E. P. GEE
ASSAM,
March 3, 1958.

5. NOTES ON THE FOURHORNED ANTELOPE *TETRACERUS QUADRICORNIS* (BLAINVILLE)

For the past four years I have kept a pair of Fourhorned Antelope *Tetracerus quadricornis* (Blainville) as pets. On several occasions they mated but had no young. Now I am happy to report that they mated on 10 July 1957 and that one fawn was born to the female on 13 March 1958. This means a gestation period of slightly over eight months, a rather long period for such a small animal. I thought this definite information concerning the gestation period of the Fourhorned Antelope might be of some scientific value; therefore, I am reporting it. Mr. S. H. Prater's THE BOOK OF INDIAN ANIMALS simply states: 'The rutting season is in the rains and the young are generally born about January or February.'

Prior to mating, the male and female usually go through a period of play, kneeling on their front knees facing each other, interlocking their necks and pushing each other with all their strength. Then the male struts about the female, lifting his legs in a curious drill-like fashion as if taking some formal exercise. After these preliminaries mating takes place.

At birth the fawn weighed 2¼ pounds. It was 10 inches high at the shoulder and 15 inches in length (nose to tip of tail). The mother antelope spends several hours daily washing the fawn with her tongue.

In the Surat Dangs most of the antelope fawns are apparently born about Deepavali time (October and November). I know of eight actual records to substantiate this conclusion.

The male antelope is a very vicious pet. During the rains he ran one of his long horns through my knee-high rubber boots, pants, and flesh, penetrating clear to the bone. I was badly crippled for more than one month. It is very difficult to enter his compound.

In captivity the Fourhorned Antelopes eat wheat or other grains, grass, leaves, figs, etc. Fresh water and salt are also kept for them.

In the Surat Dangs the Fourhorned Antelope is very common, but the Muntjac or Barking Deer *Muntiacus muntjak* (Zimmerman) is very rare. The Dangis do not distinguish between the two, erroneously calling the Antelope by the Marathi name *bhekar*. These two magnificent little animals should be carefully protected.

AHWA, VIA BILIMORA,
DANGS DISTRICT, B.S., E. M. SHULL
March 17, 1958.

[As regards the period of gestation it is relevant to note that, though the pair of antelopes were separated immediately after mating on 10 July 1957, they were together for a short time two months later. Our correspondent writes that on this occasion the female showed 'absolutely no interest' in mating, but it would be wise to wait for confirmation of the period by further observation.

In *The Transactions of the Linnean Society of London,* Vol. xiv (iii): 522 (1825), Major-General Thomas Hardwicke describes the rutting behaviour of the Fourhorned Antelope (*Antilope chickara*) thus: 'The male in the rutting season becomes exceedingly wild and mischievous, and, although partly domesticated, continues dangerously so, running at every animal within its reach, whether deer, goat, or man. Even the feeder could only approach him on the verge of the circle to which the rope he was tied with allowed him to reach.' The General's observations were made on a pair about four years in his possession, 'within which period they bred: two young ones were produced at the same birth, one male and the other female.'—EDS.]

6. EASTERN LIMIT OF THE HIMALAYAN IBEX *CAPRA IBEX SIBIRICA* PALLAS

There seems to be some difference of opinion among naturalists and sportsmen as to the eastern limit of the Himalayan Ibex *Capra sibirica.* Some say that it is found up to Garhwal and Kumaon, while others say that its eastern limit is the Sutlej River. In this respect I quote the two authorities on the subject, R. Lydekker and Major G. Burrard. The former in his book THE GAME ANIMALS OF INDIA etc. says: 'The Sakin or Asiatic Ibex, *Capra sibirica,* inhabits the mountains of central Asia, the Tien Shan, and the Altai to the Himalaya (exclusive of the Pir Panjal), and from the neighbourhood of Herat to the River Sutlej. The species is not found between the Sutlej and sources of the Ganges.'

Burrard in his book BIG GAME HUNTING IN THE HIMALAYAS AND TIBET has gone more deeply into this subject, and throws some light on the difference of opinion among sportsmen. He says: 'Although the ibex is undoubtedly the best known of all the game animals of the Himalayas, more mistakes have been made in explaining its distribution than in the case of any of its less known friends and relations. In more than one authoritative work it is described as an inhabitant of Tibet, and is mentioned as being found in the neighbourhood of Lhasa. Again it has been repeatedly declared that it is found in "Kumaon as far east as Gangotri" and the sources of the Ganges—quite regardless of the fact that Gangotri is not in the British Province of Kumaon at all, but in the protected State of Tehri Garhwal with the State of British Garhwal in between. It is difficult to understand how these mistakes arose, but I conclude they were made in the course of the collection of hearsay evidence on which some famous scientific naturalists based some of their classification. They provide an excellent example of the errors which can be made through insufficient knowledge of geography and no personal acquaintance with the actual haunts of game. The late General Kinloch, who was always so accurate in all his descriptions of the habitats of animals, never made any such error; nor did the older sportsmen, such as General Markham and Wilson ("Mountaineer"), who hunted and shot in the forties. The mistakes would accordingly seem to be of a more recent date and are all the more inexcusable. The distribution of the ibex, as far as the Himalayas are concerned, is clearly shown on the accompanying sketch. The River Sutlej is its eastern boundary and it is never under any circumstances found on the left bank of this river.'

It will be seen from the above two extracts that both these authorities agree that the ibex is never found to the east of the River Sutlej. Lt.-Col. C. H. Stockley in his book STALKING IN THE HIMALAYAS AND NORTHERN INDIA also subscribes to this view. It would therefore, be interesting to know as to who the sportsmen-naturalists were who said that the ibex was found to the east of the Sutlej also. Did these people actually see the ibex east of the Sutlej, or did they base their statements merely on hearsay? I wish Burrard or others concerned could throw more light on the subject. It would also be interesting to know as to why the ibex were not able to cross the Sutlej and extend their habitat to its east side. Is it due to the fact that the river is not fordable, even during winter? What about the snow bridges which must form during the winter over the higher reaches of the river, which would allow the ibex to pass over to its east bank? Is the terrain and the food found to the east of the Sutlej not suited for ibex? Since I have never had the fortune so far to visit the Sutlej area, I am unable to give my views on the above questions.

All the relevant books I know of were published well before the Second World War and it would be interesting to know what the latest position is in the area. One day in 1953 I happened to see a mounted ibex head at a taxidermist's shop in Dehra Dun. On enquiry I was told that it had been shot by a sportsman somewhere in Garhwal. The taxidermist, however, was not sure about this. Unfortunately at that time, as I did not know much about the habitat of ibex, I did not ask for further particulars. It makes me now suspect, however, that ibex may have crossed over the Sutlej and may now be found on its eastern side. There is no doubt that the head was that of an ibex, and with my subsequent experience of this animal in Ladakh I can now say that it must have been about 32 inches in length.

The object of this note is to elicit correct and, if possible, latest information on the subject of the eastern limit of the Himalayan Ibex. I would therefore be grateful if any sportsman or naturalist who has been in the area under consideration would kindly offer his comments or information on this controversial subject, through the *Journal.* I wonder if the Zoological Survey of India has some definite and latest information on the subject. If not, could they please have this subject investigated, when they next send an expedition to the Sutlej area or in Garhwal?

136 B.C. LINES,
MEERUT CANTT.,
February 21, 1957.

K. GUMAN SINGH,
Colonel

[From the fact that Hodgson described a variety of *Capra ibex* from Nepal in 1841, calling it *himalayanus* (*Calcutta Journ. Nat. Hist.* **2**: 414), it would appear that the ibex must occur in that area. But the exact provenance of Hodgson's type is unknown and it may possibly have come from elsewhere. No recent information as regards the occurrence of ibex in Nepal is available.—EDS.]

7. GAZELLE IN NORTH AFRICA

Lieutenant-Colonel Vladimir Peniakoff in POPSKI'S PRIVATE ARMY gives the following description of something he saw in January 1943 in Tripolitania when, in command of a motorized patrol of the British army, he was crossing the Hamada el Homra:

> 'One morning I noticed along the top of a slope on my left a multitude of small serrations bobbing up and down. Puzzled, as I thought, by a peculiar form of mirage, I drove idly up the slope: my serrations were the heads, just visible above the skyline, of a herd of gazelle, bounding along in the same direction as we were going and keeping pretty well the same speed. There were, we estimated, more than two thousand of them, in one compact mass bound on some migration of theirs across the inhospitable Hamada. Suddenly the whole herd took a right turn and joined the path of our trucks: in a moment the beasts were amongst us, so close that I had to brake sharply to avoid running one over. On every vehicle rifles came out, but such was the amazement of our men (to whom hitherto a dozen gazelle seen at one time had been a wonder) at the number and the fearlessness of the lovely animals that not a shot was fired. They ran with our moving trucks for a while, then another turn took the herd out of our path over the northern skyline.'

The patrol consisted of four armed jeeps, two or more thirty-hundredweight trucks, and two three-ton trucks.

The behaviour of the gazelle in joining the patrol and running along with it is surprising but is capable of explanation, because the movements of the herd would not necessarily be determined by the reactions of the comparatively few members of it which would be in a position to see and hear the motor vehicles. Another question suggests itself. The Lieutenant-Colonel describes the Hamada el Homra as a stony desert covering tens of thousands of square miles and marked by 'the complete absence of vegetation'—'an empty stretch of desert, without a single bush for hundreds of miles'. Where did the gazelle find food and drink?

PALI HILL,
BANDRA,
BOMBAY 20,
March 21, 1958.

D. E. REUBEN

8. NOTE ON THE USE OF BAMBOO GUN ROCKET FOR SCARING WILD ANIMALS OUT OF CULTIVATION

Some years before the Second World War 12-bore firework cartridges of German manufacture were on the market. I found that some of these, of a type bursting at the end of flight, were effective in driving elephants and other wild animals out of ragi fields. Being fired from a 12-bore gun directed at the raiding animals and bursting near ground level near or among them, the loud report and visible flash caused the raiders to panic out of the cultivation without being injured in any way.

I then decided to experiment with country-made rockets discharged from a tube as being more available and less expensive to the ryots. The first rockets were obtained from a dealer in Palghat and I used, with success, a short length of W.I. pipe. From an iron pipe I turned to lengths (2½ ft.) of bamboo, with the inner segments knocked out except for a segment at one end of the bamboo—so leaving one end closed.

Each rocket must have a bamboo (or thin stick) sliver attached to it, which keeps the rocket steady in flight. The rocket is inserted into the bamboo, head projecting from the bamboo mouth. The length of the rocket and sliver should not be more than the inside length of the bamboo.

The rocket head is then ignited and quickly pushed back into the bamboo tube and the bamboo is then held in a horizontal position, directed at the raiding animals. The aim should be correct, easily achieved by practice—not pointing downwards as otherwise the rocket will hit the ground near the firer and bound away erratically; nor upwards, as animals soon get used to explosions above and invisible to them. Correctly aimed the rocket bursts near ground level near the raiders and causes consternation and a speedy flight out of the fields. They may attempt to come in again once or twice, usually not more than twice. The rockets *must* be of a type *bursting with a loud report* at the end of flight.

These rockets are at present stocked by Modern Gunsmiths Ltd., Coimbatore, but at a price many ryots would be unwilling to pay. The fireworks manufacturers produce them cheaply, but it is essential that they are of the right kind.

A great improvement would be to get the manufacturers to insert a wick into every rocket head, the same as many types of fireworks have, which will simplify ignition. At present it is sometimes not easy on a windy or damp night to ignite the rockets.

The rockets must be made easily available to the ryot. While I was the owner of Honnametti Estate in the Kollegal Taluk, we utilised these bamboo rockets with great success in our ragi fields at the foot of the Billigirirangan Hills; and I helped the neighbouring ryots as well. But to purchase the rockets for themselves they had to travel between 20 and 30 miles to Kollegal to the one licensee stocking them there, and quite often he was out of stock. I urged on Government to permit stocks to be held by Revenue and Agricultural Inspectors, and preferably by village headmen. The black powder used in the manufacture of these rockets lasts a long time. I have rockets now in good and usable condition that I procured in 1953. Needless to say they should be kept out of the reach of children!

I notice that the newer rockets supplied by Modern Gunsmiths Ltd., Coimbatore, are of a smaller size. To be definitely effective in dealing with elephants I would advise the use of rockets double the size of those at present supplied by them.

Rockets should, naturally, be stored in a dry place.

DUPABURRAY BUNGALOW,
ATTIKAN P.O.,
VIA MYSORE,
March 21, 1958.

R. C. MORRIS

9. BIRD NOTES FROM NEPAL

The Nepal Valley is bounded on the south-east by the ridge of Phul Chowk which, covered as it is with natural forest, has always been a happy hunting ground for naturalists in Nepal. South-east of Phul Chowk lies another mountain mass, which by contrast has been totally neglected. It is connected with Phul Chowk by a narrow col at about 6,500 ft. There is almost no surface water to be found on it in the dry weather, so that camping is awkward. However, we heard that there was water at one place, and on a short leave last spring (1957) decided to explore the area, as there was no time to get up to the high hills north of Kathmandu, which were our main objective. We found the country most interesting.

The ridge is about 5 miles long, and some 3 miles of this lies above 9,000 ft. It is known as the Nangi Danda. At the SE. end it falls away to another col 7,500 ft. and then rises and ends in the mountain Narain Than, just over 9,700 ft. We had no time to explore Narain Than, but could see great bare cliffs where perhaps the swifts breed. On Nangi Danda were many plants not usually found on Phul Chowk. Some of these, like *Berberis wallichiana,* grow here down to 8,000 ft. as they do on the higher hills, but on Phul Chowk and Sheopuri which just touch 9,000 ft. they are not found. I suppose they need a greater area above 9,000 ft. to grow at all. The chief interest of Nangi Danda are the stands of magnificent *Tsuga brunoniana,* the *tengre salla* of the Nepalese. These trees do not grow in any numbers anywhere else round the Kathmandu Valley. There is also a great deal of hill bamboo. We camped at the only spring, Kali Pani, where the scanty water rather lived up to its name but was cold and quite pure, once the vegetable matter had been strained away. It was at about 9,300 ft. elevation. We were there from April 11th to 16th, when the following bird notes were made. A month later would have been better, as by then all the migrant birds would have left, but we should have missed the glory of the tree rhododendron. As it was, these were in full flower, pink, white, and red, a most beautiful sight, which we had not expected as they were already over on Phul Chowk. *Skimmia laureola* was also in flower, smelling delightfully of orange, and there was an occasional tree of the wonderful magnolia (*campbelli* ?) with huge waxy white flowers on the still leafless branches. The ridge is uninhabited during the dry weather, and the forest has no doubt been preserved by the lack of water. Every day whole families come up from the villages below to collect firewood, grass, and oak leaves for their buffaloes. The oaks (*Q. semecarpifolia*) are in the same sad condition as they are in most places in Nepal near villages. They have almost no branches, the leaves sprouting close to the trunk on small stunted twigs. However, we saw plenty of young trees about, and the people assured us that the leaves had been cut and the branches lopped for generations without killing the trees. During the monsoon, when there is enough grass for the cattle, the trees are allowed to rest for a few months. During the rains, small streams appear everywhere, and we saw the remains of scanty huts where the herdsmen live for a few months with their animals, but there is then enough grass for the oaks to be left alone. Owing to the lack of water very few wild animals were seen, except the odd barking deer near the spring.

Nucifraga caryoctactes hemispila Vigors: Himalayan Nutcracker

This bird is common on the high hills north of Kathmandu, above 9,500 ft. in the blue pine and juniper forest. I have never seen one anywhere near the Valley, but they were established in the *Tsuga* forest. A family party lived near the camp, 3 young fully fledged but still being fed by their parents. They had a regular routine and would fly through the camp in the morning, spend the day crossing 2 ridges of *Tsuga*s, N. of the camp, and return each evening about 5 p.m., roosting for the night in a big clump of *Tsuga*s quite close to us. We saw other birds, singles and pairs, on the ridges to the south, but no other young birds. Judging from the extent of territory used by this family party, the numbers of birds cannot be very large. I should guess only 4 or 5 pairs for the whole *Tsuga*-covered area. It would be interesting to know what the area of an isolated group like this must be, for it to maintain itself. Of course the numbers may be augmented by fresh individuals from the higher hills.

Paradoxornis nipalensis Hodgson: Ashyeared Suthora

These little birds are found on Phul Chowk, but were very much commoner on the Nangi Danda, where there is a much greater area under bamboo. They never leave the bamboo. We shot a non-breeding female. I imagine they nest during the monsoon.

Kitta flavirostris (Blyth): Yellow billed Magpie

This Magpie replaced the red billed bird everywhere on the Nangi Danda ridge. On Phul Chowk both occur, but the yellow billed species is very scarce and only found in a small area round the top of the mountain.

Certhia nipalensis Blyth: Tree Creeper

A single non-breeding female was shot. This is the only one I have seen during ten years of bird watching in Nepal. It seems to have a curious distribution. Dr. Fleming shot a bird near Pokhara, many miles west of Kathmandu. This must be the most westerly record. Otherwise I know of none seen or collected west of East Nepal. When in London this autumn I compared my bird with those in the British Museum collection. It was very like the Darjeeling specimens. There was only one faded Hodgson skin from Nepal, with no locality. Birds from SE. Tibet were very different, and I should have thought two races were involved. Normally *C. discolor* is the common low level (5,000-9,000 ft.) tree creeper, and *C. familiaris* the high level (9,000-12,000 ft.) bird here.

Alcippe v. vinipectus (Hodgson): Hodgson's Fulvetta

These birds breed on Phul Chowk, but were much more abundant on the Nangi Danda. Breeding was in full swing in mid-April, some birds still building, but most incubating. 6 nests examined, each contained 2 eggs.

Yuhina o. occipitalis Hodgson: Slatyheaded Ixulus

These birds were also very common and breeding.

Zoothera dauma dauma (Latham): Smallbilled Mountain Thrush

Very common, in pairs. For the first time I heard this bird's song. They were singing everywhere, usually from a small bushy tree about 8 ft. from the ground, and were so engrossed that one could get very close to them. They sang on and on for hours with very little variation. They have a few fine notes, but these are connected by a curious medley of squeaks and chuckles, very inferior to the song of other thrushes, or even of the Rock Thrushes. I was very glad to hear this usually silent bird so noisy.

Turdus ruficollis was still present in huge flocks, but we saw neither *Zoothera dixoni* nor *Z. mollissima,* which I think leave early for their breeding quarters.

Seicercus burkii (Burton): Blackbrowed Flycatcher-Warbler

Common in pairs and singing, so no doubt they breed here as they do sparingly on Phul Chowk.

Phylloscopus p. pulcher Blyth: Orangebarred Leaf Warbler

Common and singing, but not paired, and as they do not leave Phul Chowk until the middle of April, these were probably also non-breeding birds.

Phylloscopus m. maculipennis (Blyth): Greyfaced Leaf Warbler

Common in pairs, and breeding in the bamboo. A breeding male was shot, and I saw several birds carrying nesting material. They also breed on Phul Chowk, in bamboo above 7,000 ft.

P. r. reguloides (Blyth): Blyth's Leaf Warbler

Very common in pairs and singing continuously. They also breed on Phul Chowk and Sheopuri.

P. magnirostris (Blyth): Largebilled Leaf Warbler

Not seen. We were probably too early for them. They breed on both Phul Chowk and Sheopuri above 7,000 ft. but I have never heard the distinctive song before the end of April, and not commonly till early May. They frequent broad-leaved tree forest rather than bamboo, and perhaps the Nangi Danda is not suitable for them.

P. n. nitidus Blyth: Green Leaf Warbler

A good many seen, and a single non-breeding male was shot. They were singing as they always do on the migration.

Horeites brunnifrons (Hodgson): Rufouscapped Bush Warbler

Common but not paired off and may have been still on migration.

Tesia castaneocoronata (Burton): Chestnutheaded Ground Warbler

This bird is common on Phul Chowk but here it was absolutely abundant. They were in pairs calling and singing all day, and were found everywhere in bamboo, amongst ferns in nallas amongst *Viburnum* bushes, etc. One day I watched 2 birds displaying. They were in the same bush, but one kept mostly to the upper branches, where it ran or rather strutted backwards and forwards with wings drooping, bill turned straight upwards, yellow throat puffed out, tiny tail held bolt upright, uttering a continual rapid '*tsk tsk tsk*' on and on, occasionally varied by the very similar song '*tik*$^{\text{ti ti}}$ *tik*$^{\text{ti ti}}$'. The second bird behaved in exactly the same way in the lower part of the bush. Their excitement was so intense that the birds took no notice of me. I could have caught them easily. Every now and again the 2 birds would approach each other, the excitement rising to fever pitch, but when about 2 inches apart they would turn away and resume their usual positions but with somewhat lessened excitement. This was repeated again and again, and after half an hour of it I was obliged to leave them still at it, so never discovered if they were a pair in some sort of courtship display or 2 males challenging each other.

Rhipidura hypoxanthum Hodgson: Yellowbellied Fantail Flycatcher

These were common in pairs and I imagine breed here, as they have left the hills round the valley by the middle of April. An occasional pair breeds on Phul Chowk. Flocks of small finches were seen which I think were siskins (*Carduelis thibetana*), but could not be sure and we failed to collect one. They are said to breed in larch forest, I wonder if *Tsuga* trees would do as well. It is only a short flight to Godavari at the foot of Phul Chowk where they winter in large flocks in the alders.

Apus pacificus Latham: Whiterumped Swift

Flocks of these birds were seen flying over the ridge. They were also seen over Phul Chowk in April and May, and I think probably breed on the cliffs of Narain Than.

Spizaëtus nipalensis Hodgson: Hodgson's Hawk-Eagle

A pair of these splendid birds occupied the Nangi Danda ridge. They are also seen on Phul Chowk, and perhaps the one pair needs the whole territory. Black and Serpent Eagles occupied the valleys between Phul Chowk and Nangi Danda, but were not seen on the ridge itself.

Arborophila torqueola (Valenciennes): Hill Partridge

Very common. The single plaintive whistle would sound morning and evening round our camp. They were very partial to the bamboo jungle.

BRITISH EMBASSY,
KATHMANDU, NEPAL, (MRS.) DESIRÉE PROUD
March 25, 1958.

10. WOODPECKERS DRUMMING

I was very interested to read the note in the *Journal* for April 1957 on the drumming of woodpeckers. As this is usually only heard in spring, I have always imagined it was in some way connected with the breeding display. I have observed the following woodpeckers drumming in Nepal:

Picus canus Gmelin: Blacknaped Woodpecker. I see this bird is included in your list of Woodpeckers which drum. It is common here, and the 4-syllable whistle is heard from March to May, but curiously I have never heard it drum.

Picus chlorolophus Vieillot: Lesser Yellownaped Woodpecker. Only occasionally in spring.

Dendrocopos hyperythrus (Gould): Rufousbellied Woodpecker. Drums frequently in May, usually on *Quercus semecarpifolia.* Not heard in any other month.

D. macei Vieillot: Fulvousbreasted Woodpecker. Heard only once, a very gentle drumming in late February.

D. auriceps (Vigors): Brownfronted Pied Woodpecker. Frequently heard and seen drumming for considerable periods during late March and April.

Micropternus brachyurus (Vieillot): Rufous Woodpecker. This is the master drummer of them all. As the birds select each year a clump of bamboos in the Indian Embassy garden where I can watch them from my window, I have kept careful notes of the dates. The earliest date is about the end of March, but this is a half hearted affair; the real drumming starts about 12th April, reaches a climax about the 16th, and is heard no more after 21st April. There are always two birds present, but only one (the male?) drums; the second bird appears to take no interest. The drumming starts gently, works up to a reverberating crescendo of sound which can be heard nearly half a mile away, and then gradually slows down and stops. There is usually a 2- or 3-minute interval between the bouts of drumming, while the bird sits quietly on some side branch. It then hops back on to the main bamboo stem and the whole thing starts again. For a day, or two at most, this goes on for the greater part of the day, then it is heard infrequently for a few days longer. I have never heard this woodpecker drum on any other trees than bamboos.

Picumnus innominatus Burton: Speckled Piculet. I have often seen this bird drumming quietly, and I rather think at any time of the year, but am not quite sure of this.

BRITISH EMBASSY,
KATHMANDU, NEPAL, (MRS.) DESIRÉE PROUD
March 25, 1958.

11. BLUETAILED BEE-EATER *MEROPS PHILIPPINUS* LINNAEUS IN WESTERN SAURASHTRA

On Sunday, 11 May 1958, I drove out about 11 miles from Veraval on the west coast of Saurashtra to a place called Sutarapada on the west coast. On my way back just a few miles from this village I saw large flocks of what were unmistakably Bluetailed Bee-eaters. I estimated the flock, which was loosely scattered over barren ground and ploughed fields, to consist of at least 60 to 80 birds. They were flying low over the ground and settling now and then on low stubble and clods of earth, uttering subdued calls *chivip, chivip*, a sort of rippling sound and not the usual *pruk, pruk*. The birds were in full plumage, and appeared smaller in size than the Bluecheeked Bee-eater. They emitted a series of different call notes and appeared to be migrating in a north-westerly direction. They allowed close approach from the car and I watched them at a distance of ten to fifteen yards. The birds were feeding on insects that were flushed from the ground or had arisen on their own. The blue tail of this species showed up clearly, and I had not the slightest doubt about its identification. This was the first time I have seen these birds in Saurashtra but, as I had not surveyed this particular area before, it might easily be that the birds migrate through this area fairly regularly.

At Prabhas-Patan I saw the Bluecheeked Bee-eater in full plumage; its call note appeared louder and in a lower key, though the difference may be very small between the calls of the two species.

DIL BAHAR,
BHAVNAGAR, R. S. DHARMAKUMARSINHJI
SAURASHTRA,
June 7, 1958.

12. THE EASTERN SWIFT *MICROPUS APUS* IN SAURASHTRA

On 25 May 1958 at 10 a.m., Shivrajkumar and I were watching a huge concourse of Common Indian House Swifts hawking midges over the Alansagar reservoir two and a half miles from Jasdan. Among the swifts, there were Indian Sand Martins, Dusky Crag Martins, Wiretailed Swallows, and Redrumped Swallows. Suddenly a large swift flew past us at great speed and we had the opportunity of looking at it both from above and below as it circled back. We watched its amazing aerial acrobatics for a quarter of an hour. Its larger size and faster flight made it distinct among the smaller and slower Common Indian House Swifts. The absence of the white rump patch and the forked tail were also good distinguishing features, while its uniformly dark brown plumage (not pale smoky or mouse-brown as in *Apus murinus*) relieved by a white chin and throat separated it from the Alpine Swift which often occurs in our skies on foraging flights, and convinced us that it was an example of the Eastern Swift *Micropus apus*.

This swift is very common in the Himalayas around the higher summits of the foothills and their great flocks wheeling and twisting overhead are an unfailing source of joy to the watcher below. It would be interesting to know of other records from the plains, as in Stuart Baker's FAUNA this swift is said not to occur in the plains of India though it does winter in Cachar and the Andaman Islands. Could this be a bird on return migration having been drawn down by the great flock of feeding swifts and swallows? The exact status of many of our birds especially the migratory species would undergo considerable change if a greater number of watchers were to scan the skies and countryside of India.

SAURASHTRA,
JASDAN, K. S. LAVKUMAR
May 25, 1958.

13. DELIBERATE DROWNING BY A RAPTORIAL BIRD

In the *Journal* for April 1956 (**53**: 476) Mr. M. A. Wynter-Blyth has referred to a wounded teal on water being swooped upon by a 'blackish brown bird of prey of heavy flight, slightly larger than the common kite'. After a few unsuccessful attempts the raptor settled on the teal on the water and though once disturbed it returned and, when after some time it was again driven away, the teal floated up dead, apparently drowned.

Recently while shooting duck at an irrigation tank in the Nasik District, Bombay, I had a very similar experience. I was hidden in a clump of rushes on the edge of a marsh about 20 yards away from broad slow-moving water. A pair of garganey flew straight into me and with the second barrel I winged the drake which fell into the stream some 80 yards away. My retriever boy had already started making excuses about his inability to reach a bird so far out, when we saw a marsh harrier swoop upon it. Though it appeared to seize, it could not lift the duck out of the water and, after two or three attempts, the harrier flew to the shore and rested for a few minutes. It then returned and settled right upon the duck with its wings spread out, obviously holding the bird under water. The duck was not visible but there can be no doubt that it was so held, as it would otherwise have come up some distance away and been visible in the open water. For four minutes the harrier stayed in this position, and then flew away with nothing in its claws. Both birds were slowly drifting with the current and, though I saw the garganey again, some duck flying past distracted my attention and in the fading light I did not see it any more.

I have been shooting over this area for 25 years, and it is gratifying to note that the spotbill which had almost completely disappeared are now back in some numbers. The total number of birds is not what it used to be, but the cotton teal which I had not noted earlier has been visible in small flocks over the last few years.

C/O FAIZ & CO.,
75 ABDUL REHMAN STREET, HUMAYUN ABDULALI
BOMBAY 3,
March 20, 1958.

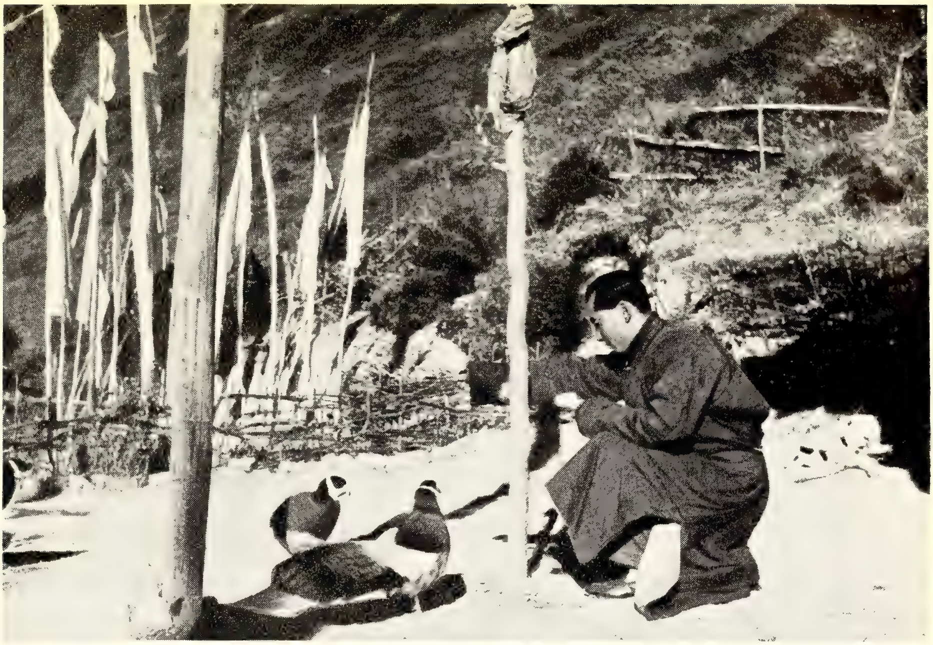
[In Vol. **52**, p. 665, a Gleaning is published of a swan being deliberately drowned by a cormorant.

Mr. Sálim Ali recalls a Pallas's Fishing Eagle on the Keoladeo Ghana at Bharatpur making a sudden swoop on a flock of coots on the water causing the birds to spatter and scatter and pouncing on an individual that had got separated. After catching it in its talons the eagle sat on the struggling bird now completely submerged together with a part of the eagle's tarsus. It sat thus for a couple of minutes in an apparently calculated matter-of-fact manner, and when it rose in the air a limp dead coot was dangling below it. It was obvious that the coot had been killed by drowning. But how had the predator learnt this technique?—EDS.]

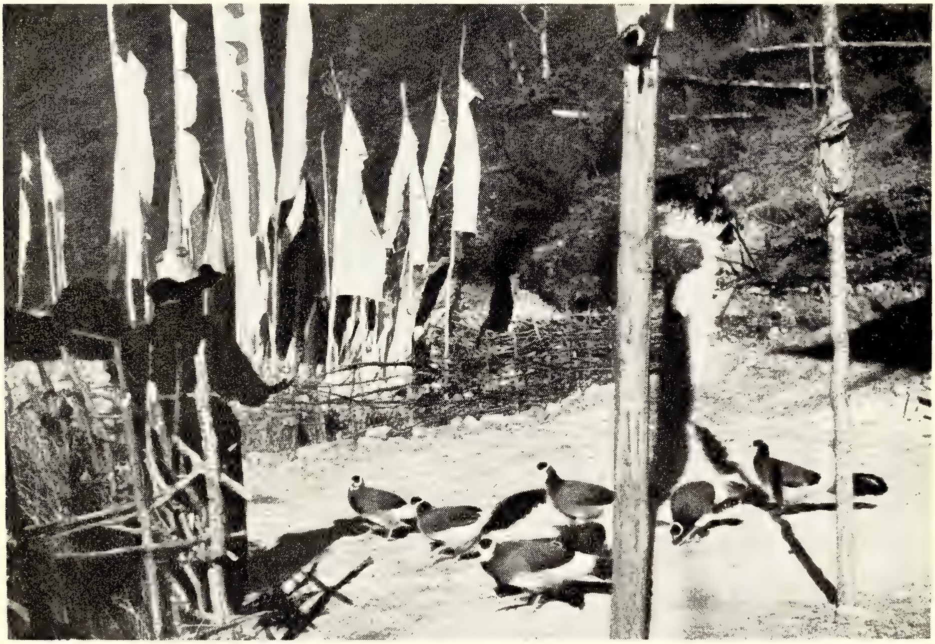
14. ELWES'S EARED PHEASANT (*CROSSOPTILON C. HARMANI* ELWES) IN TIBET

(*With a plate*)

In March 1956 I received a letter from His Highness the Maharaj Kumar of Sikkim which read: 'I have had a very interesting trip to Lhasa and, further east, to a point directly north of the Mount Nacha Barwa at the bend of the Brahmaputra. Whilst there I have taken pictures of some pheasants which, although they are in the wild state, eat out of one's hand because there is none there to make enemies. This particular type of pheasant we do not get in Sikkim, but in Tibet they seem to thrive along the Brahmaputra Valley and its tributaries at a height of about 8 to 15 thousand feet where there are some shrubs or small type of oak trees. I gather that there is a similar bird in Kham side, further east, but it is not of the same colour—more white.' With a subsequent letter, His Highness sent me some photographs showing the extraordinary tameness of these pheasants known as *Cha-gnah* in Tibet, and wrote: 'You will see from the pictures that the birds are being fed at close quarters; they were taken at a remote monastery in Kongbo Valley. The birds here went in two or three coveys and the total may have been as many as fifty or sixty birds. In size they are as large as the male Himalayan Monal Pheasant, and their food seems to be similar to the Monal's. Although they can fly as well as any pheasant, but perhaps not so far, they seem to live always on the ground. I have never seen one actually on a tree. Their distribution seems to be along the valleys of the Brahmaputra and its tributaries from the junction of the Kichhu (the Lhasa river) eastwards. I have seen them as high as



H.H. The Maharaj Kumar of Sikkim feeding Elwes's Eared Pheasants



Wild birds at a monastery in the Kongbo Valley of Tibet

Photos : Maharaj Kumar of Sikkim

13,000 ft. where there are only shrubs. I do not know how far down they go as my travels inside Tibet did not take me lower than 7,500 ft.'

Early history:

Crossoptilon c. harmani first came to the knowledge of science in 1880 by way of a skin 'in a terribly moth-eaten state' which was accidentally discovered by Elwes in the room of Lieutenant Harman of the Survey of India. It had been obtained by the monk Nem Sing in the Tsangpo Valley, 150 miles east of Lhasa, in the neighbourhood of Nang Dzong, or Kyimdong Dzong, at a height of about 10,000 ft. After this first discovery no more skins of the bird were collected for another 33 years until 1913, when Bailey and Morshead brought back a series, again from the Tsangpo Valley.

Distribution:

Ludlow gives the distribution of the bird as follows: 'It is possible to define the western boundary if this bird's distribution with some degree of accuracy. It does not occur in the basin of the Manas, but is found in that of the Subansiri, north of the main range, from long. 92° 30′ E. In the Tsangpo Valley, however, it extends as far west as long. 91° 33′, having been found first by Bailey and subsequently by Battye (*JBNHS* **38**: 626) in the valley south of Lhasa near Samye Gompa. I can find no record of its distribution north of Lhasa.

'Eastwards, Bailey found traces of this pheasant in Pome (*JBNHS* **24**: 77), and in 1938 I saw it at Gyala, and also at Pangkar, north of Gyamda Dzong (long. 93° 30′ E., lat. 30° 15′ N.). But it probably extends still further eastwards to the Salween Valley, for Kaulback in his book entitled SALWEEN records slaty-blue Crossoptilons in approximately long. 95° 30′ E., lat. 31° N., where apparently it meets the typical race.'

Ludlow believes that the bird does not occur south of the main Himalayan axis, despite Stuart Baker's claim that he had 'four eggs taken in the Abor Hills on the 26th of May'.

Habits:

It is said that this bird exists in large numbers wherever it is to be found. It keeps under cover of the forest, and will not venture into the open except in the mornings and evenings. When disturbed it will run uphill, and takes to the air only if forced to do so. Lt.-Col. F. M. Bailey told Stuart Baker that beaters, on seeing the bird, will imitate the barking of a dog; this has the effect of making it fly into a tree where it is easily shot. Unless it hears this sound, the bird will fly a great distance before it settles.

In the mornings and evenings the birds come out to feed on open grassy hill slopes near rhododendon and juniper scrub. Its call, uttered most frequently in the early mornings, is loud and harsh and may be heard from as great a distance as a mile away.

Ludlow, like His Highness the Maharaj Kumar, found that 'where unmolested, this bird is remarkably tame, and at Chikchar it strutted about in front of our camp like a barndoor fowl'.

A nest found on the 23rd May was 'placed under a fallen fir tree, and was composed of the bark and rotten pulp of the tree and lined with moss. It contained nine unspotted, cream-coloured, hard-set eggs, averaging 55.50 × 42 mm.'

CATHAY BUILDING,
SINGAPORE,
MALAYA,
February 20, 1958.

LOKE WAN-THO

15. OCCURRENCE OF THE GREAT SKUA (*CATHARACTA SKUA LÖNNBERGI* MATHEWS) AT MALWAN, RATNAGIRI COAST (BOMBAY)

Following up newspaper reports regarding large numbers of birds washed up at Malwan, Ratnagiri District, 350 miles south of Bombay, we received with the assistance of the Director of Fisheries, Government of Bombay, a specimen of the Great Skua, which has been identified by Major W. W. A. Phillips at the British Museum (Natural History) as *Catharacta skua lönnbergi* Mathews. This is of considerable interest as the only previous record of this species in India is a single example captured by fishermen in an exhausted condition near Trivandrum, Travancore.

The reports in the local papers were widely conflicting and we have obtained a note from R. G. Weingankar, Editor of *Janayug Weekly* at Malwan, in which he says that a first flock of 127 was washed up at Chivla near Malwan, between 15th and 18th June 1957, and about the same time another 155 birds at Talashil and Sarjekot in neighbouring areas. A few days later 7 more birds were found at Chivla and 28 at Devbag, Mobar, and Nevali in the second week of July.

The specimen received by us was a single bird washed up at the Stone of Moria about two miles south of Malwan on 5th August, and the other 317 birds reportedly along a stretch of coast about 12 miles in length. Most of the birds are said to have been washed up alive, and the point specially made is that none of them were eaten by dogs.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
BOMBAY 1,
April 3, 1958.

EDITORS

16. SANDWICH TERN [*THALASSEUS SANDVICENSIS SANDVICENSIS* (LATHAM)] IN SAURASHTRA

On 9 May 1958 I was out 'birding' at the mouth of the Hiran River near Prabhas-Patan which is three miles from Veraval on the west coast of Saurashtra. On the estuary I saw flocks of Lesser Crested Terns, some Gullbilled Terns, and Whiskered Terns. On the sandy banks of the estuary, walking close to the settled birds I was able to approach to about 40 yards after which I sat down and moved myself slightly closer. All the birds seemed to be well known to me, but scrutiny of individual birds with my 9×34 binoculars disclosed a tern which had a yellow tip to its black bill. This tern was about the same size as the Gullbilled Tern, and evidently was not in full plumage; the crown appeared greyish with a dark blackish nape, the upper parts were pale grey, the lower parts white, and the feet black. As this bird was new to me I made notes and looked up A FIELD GUIDE TO BIRDS OF BRITISH ISLES AND EUROPE by Guy-Mountfort and Roger Peterson. In this book the field characters on p. 156 and plate No. 41 disclosed that the bird I had seen was the Sandwich Tern. I must mention that without the binoculars it was not easy to trace the yellow tip to the black bill, which was more slender and, if anything, longer than of the Gullbilled Tern.

The tail of the sandwich tern seen in flight was slightly forked. I watched another bird of the same species also solitary but mixing with the terns already mentioned on 12 May. This, I believe, is a new record for this area.

DIL BAHAR,
BHAVANAGAR,
SAURASHTRA,
June 7, 1958.

R. S. DHARMAKUMARSINHJI

17. OCCURRENCE OF THE RED SEA MASKED GANNET (*SULA DACTYLATRA* LESSON) AT NASIK, BOMBAY STATE

Following up newspaper reports in July 1957 about a 'radio-active' bird having been obtained at Nasik, about 70 miles inland and north-east of Bombay, we have received from the Ferguson College, Poona, the head and legs of a Red Sea Masked Gannet (*Sula dactylatra*).

Though we have been unable to obtain any further information regarding the 'radio-activity', the occurrence so far inland of this purely pelagic bird is worth noting. There are only half a dozen earlier records of this gannet from the Bombay sea-coast, all storm-tossed individuals during the south-west monsoon in July/August.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
BOMBAY 1,
March 31, 1958.

EDITORS

18. OCCURRENCE OF THE LARGE WHISTLING TEAL *DENDROCYGNA BICOLOR* (VIEILLOT) IN BOMBAY

The Large Whistling Teal *Dendrocygna bicolor* (Vieillot) is accepted in all standard works as a relatively rare species but generally distributed all over India. There are exceptionally few records from peninsular India, and I have only been able to trace the following:

> *Fairbank, Stray Feathers* **4**: 264 (1876), 'obtained a pair once near Ahmednagar, but I have seen them on no other occasion'.
>
> Wenden, *Stray Feathers* **7**: 92 (1878), in a contribution to the avifauna of the Deccan, states that he is sure that he has observed this species at Nulwar (Gulburga District) and shot several in 1873.
>
> Annandale, *Rec. of Ind. Mus.* **22**: 330, mentions that a pair frequented Barkuda Island in the Chilka Lake throughout the rains of 1919, and probably bred upon it.

On 8 December 1957 I was out on Lake Beale, Nasik District. The duck were wild and in the absence of cover very few shots had been fired during the morning. We took a boat with an outboard and a one-man canoe to Dhamangaon about 8 miles away. Several flocks of a hundred or more duck were seen at different places on the bare shore-line, but with nothing before or behind which afforded any kind of cover they usually rose well out of range. On one occasion I was in the canoe, but as there appeared to be no chance of getting any nearer than usual I watched the birds through glasses at about 150 yards. The larger number were Pintail and Common Teal, but a pair of Whistling Teal stood out conspicuously different among them. Even on land they appeared to be exceptionally large, and after a while when my fellow guns approached the birds from the other side and put them up I had a good opportunity of watching them in flight. They did not flutter in the un-ducklike manner of the Small Whistlers, but their flight was quicker and more direct, easily keeping with the flights of Pintail as they soared away. I was sure that I had seen a pair of Large Whistling Teal and upon return I saw that Stuart Baker in INDIAN DUCKS AND THEIR ALLIES refers to their being 'wilder birds than their smaller cousins, and also stronger and quicker on the wing'.

Subsequent to this on the 17 June 1958 I was at Powai Lake, Salsette Island, Bombay. The late monsoon had left large areas of land exposed to water, and we saw a flock of about 50 Whistling Teal settled on the shore far away. We rowed up to within 40 yards before the birds took off, and in the meantime had excellent opportunities of glassing the settled flock. Among them were two individuals which stood much higher than those around them, and were undoubtedly different. Mr. N. J. Northover who was handling the boat and Dr. E. G. Silas both had a look at the birds through binoculars and confirmed the difference in size. Also, in accordance with the dichotomous key in the FAUNA, the upper tail coverts were of a paler colour as against the darker ones in the smaller species.

It is indeed strange that I should have twice come across this species at such short intervals and I wonder if it has not been overlooked by shikaris and others.

c/o FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY 3,
June 23, 1958.

HUMAYUN ABDULALI

19. OCCURRENCE OF THE BAIKAL TEAL *NETTION FORMOSUM* (GEORGI) IN ASSAM

You will be interested to hear that on Sunday morning I shot what appears to be a rare duck for India. I didn't know what it was, but I have since identified it positively (with the help of Stuart Baker's book) as a Baikal (or Clucking) Teal, which I gather is fairly common in South China and Japan, but a very rare visitor to India. It was a drake in full and very beautiful plumage, and a single bird.

Digboi P.O.,
Assam, C. D. HOPPER.
March 10, 1958.

[The Baikal Teal is a rare winter visitor to India but its occasional occurrences have been reported in this *Journal* from time to time in widely scattered places such as Delhi, Hardoi, Rewah State, Saran Monghyr, Darbhanga, Purneah, Manipur, Sindh, and Ahmedabad. *The Statesman* of 1 June 1949 had a report of three Baikal Teal netted in Lucknow, and presented by Mr. P. K. Sen Gupta to the Calcutta Zoo. This elicited a note from the late Mr. C. M. Inglis that several records from Darbhanga had been published in the *Journal of the Bengal Natural Hist. Society* and a further letter from Mr. T. F. Robinson of two shot in Upper Assam. In Vol. **21** (p. 1090) of the *Journal* is published the record of one shot near Sibsagar in January or February 1910. It breeds in N. Asia, from Lake Baikal east to Mongolia, Manchuria, Japan, and N. China.—Eds.]

20. WATER BIRDS AND OUR IRRIGATION SCHEMES

Apart from the conscious efforts of the authorities to include conservation of the fauna and flora in the Five-Year Plans, it is interesting to note that our birds and animals are also benefiting from the river valley projects, such as the one at Malampuzha, Palghat. The reservoirs not only provide the animals and birds with a never-failing source of water but, by cutting off certain parts of the mountain from 'civilization' (with its jeeps and guns), they afford greater safety to them. If the rules that are displayed on boards near the dams regarding the use of fire-arms are enforced strictly, some of these catchment areas could well serve as wild life sanctuaries too. We have the excellent example of the Periar sanctuary to prove this.

The Malampuzha reservoir was filled for the first time, if I am not mistaken, in 1953. A large number of coconut and mango trees were partly submerged and the latter soon lost all their leaves and began to decay. Water birds did not take long to discover the newly-formed lake, and egrets and small waders began to be seen regularly in the place. On 11 September 1955, on one of my periodical visits to the reservoir, I found some nests and what I thought were cormorants on some of the dry mango trees that were far away from the dam-site. On the 16 October, thanks to the kindness of one of the engineers, a few friends and I were able to go round the lake in a boat. When we neared the trees it was found that the breeding birds were not cormorants, but darters (*Anhinga melanogaster*). There were no cormorants at all in the lake. We saw more than 16 nests. There were about 25 adult darters and 10 juveniles. I learnt that some of the staff had raided the nests a few days earlier and removed a number of eggs and young ones. One of the nests we saw appeared to have eggs or callow chicks in it. A crow tried to take advantage of our visit to steal the contents of this nest, but 3 adult darters flew to the tree and, to the accompaniment of loud *kle-kle-kle* calls, put the crow to flight.

I was not able to discover whether the darters had nested there in 1954. However, the fact that a colony was well established in 1955 shows that the birds took only a couple of years to find the new nesting sites provided by the reservoir and its trees. Enquiries made of local shikaris proved that darters had never been found there before the lake was formed.

On all subsequent visits I have found darters in the lake. What will happen to the colony when the trees rot away and disappear remains to be seen. If the larger trees that still stand on some of the islands are not cut away, the birds may choose to build in them.

Other water birds, never seen in Palghat before the formation of the lake at Malampuzha, are Openbill Storks, White Ibis, and Little (?) Cormorants. These have not become regular visitors yet.

It may be suggested that employees of the P.W.D. may be given special instructions not to interfere in any way with the birds and animals that appear near the reservoirs of these dams.

I was interested to see that the chicks of the darter (which, at a distance, could easily be mistaken for egrets of some kind owing to their white plumage) rarely submerged even when pursued in the boat. Is diving an accomplishment that comes later?

GOVERNMENT COLLEGE,
CHITTUR-COCHIN,
KERALA STATE,
June 5, 1958.

K. K. NEELAKANTAN

21. EGG-LAYING HABITS OF SEA TURTLES DESCRIBED IN THE TAMIL SANGAM LITERATURE

Several occasional references in the ancient Indian texts enable us to visualize not only the ancient Indian fauna and our knowledge concerning them, as shown by Hora (1935, 1951, and 1953), Jayaram (1950), and Rao (1957), but also indicate to what an extent our ancients showed an interest in natural history.

In the Tamil Sangam Literature (*circa* 4th century A.D.), a short poem written by the poetess Kumizhi Gnāzhalār Nappasalaiyār in *Aghanānūru* (Stanza 160: lines 3-8) gives a brief but remarkably accurate account of the breeding habits of the Indian sea turtles. The accuracy of her observations is rivalled only by the recent similar observations on the Indian sea turtles by Mawson (1921), Cameron (1923), and Deraniyagala (1930):

The Poem

'Adumbukodi sidhaiya vānghi kodunkazhi
Kuypai venmanal pakkam sērthi
Niraitchool yāmai maraithēnru puthaitha
Kōttuvattu vuruvin pulavunārum muttai
Pārpida nāgum alavai pakuvāi
Kanavan ōmbum'

Translation

The laying turtle collects and brings a bundle of *adumbu* creepers,
Keeps them beside the heap of white sand to conceal (lines 3-5)
Egg, white as elephant tusks and round as well as foul smelling. (line 6)
With open mouth, the male awaits the hatching of the young ones. (lines 7-8)

Nappasalaiyār, while describing the scene of a sea-shore at night, records how a turtle walks across the beach beyond the tidal zone, collects a few creepers of *Ipomaea biloba* (*adumbu kodi*), and camouflages the eggs concealed in sand. Mawson (1921) observed *Chelonia mydas* similarly covering the nest with some weeds. No one else has recorded this habit in Indian turtles excepting Nappasalaiyār and she is even more specific and probably correct in noting the weeds to be of *adumbu kodi* which, as identified by Lourduswamy (1953), is *Ipomaea biloba*, a common weed on the Indian sea-coast.

The various other details concerning the shape, colour, and smell of the turtle eggs as described by her are correct, but the last point that the male keeps waiting (guarding ?) till the hatching of the young ones is not, as far as I know, either recorded or noticed in sea turtles. Nor is it practicable for a male turtle to keep so long exposed to the dangers on the beach. Nevertheless, it may be a point worth putting to observation.

This contribution of Nappasalaiyār to ancient Indian natural history is of interest because the various details and the sequence of events during the rather elaborate process of the egg laying of sea turtles, described by her, agree closely with our present knowledge on the subject and, especially in view of the fact that our earliest accurate but short account of the sea turtle (Loggerhead) breeding, mentioned in the Old John Speed Atlas, dates back only to 1622. The above description of Nappasalaiyār (*circa* 4th century A.D.) is clear evidence not only of the keen interest that our ancients evinced in natural history but also of their remarkable powers of accurate observation and description.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM.
P. J. SANJEEVA RAJ,
M.A., F.A.Z.

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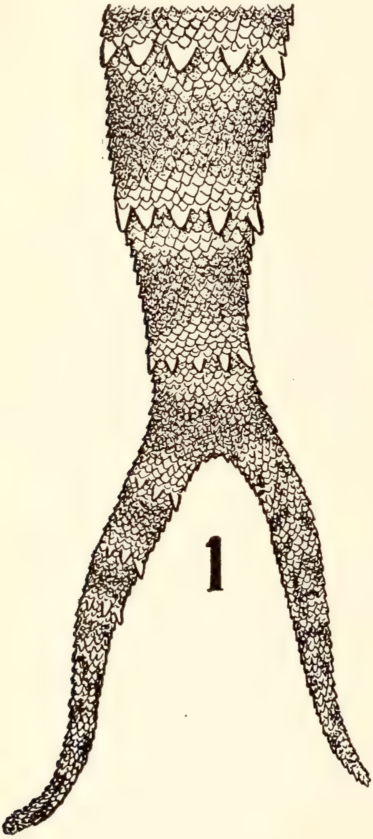
22. ON THE ABNORMAL TAIL OF A GECKO

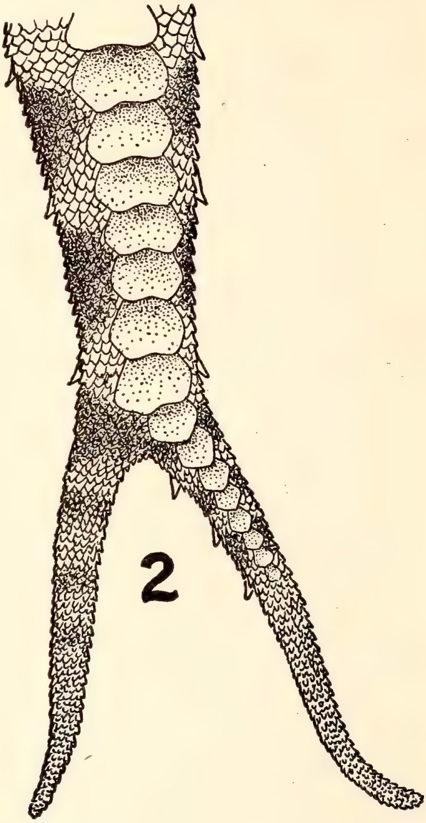
It is common knowledge that geckos can snap off the tail at will and regenerate new ones. In most cases this new tail appears as a continuation of the original one and is exactly similar to the lost one in most of the important characters. Hora (1926, *Rec. Ind. Mus.* **28**: 193) recorded a specimen of *Hemidactylus brooki* Gray with a triradiate tail. The tail was composed of a normal median limb and two perfectly symmetrical short limbs starting from the base of the former. The following note is based on a specimen of *Hemidactylus brooki* caught from the Marine Biological Laboratory, Trivandrum.

The major part of the tail is normal, clearly showing the dorsal scutes and the ventral plates, but the distal one-fifth is clearly forked. The fork is asymmetrical, the left limb being slightly longer and more slender than the right. The left limb possesses the dorsal scutes and the ventral plates characteristic of the species, but both scutes and plates are absent on the right limb. The external characters thus clearly indicate that the left limb is the normal original tail and the shorter right limb an abnormal development. The growth of the accessory limb slightly displaced the original tail, producing a dichotomous appearance.

The skeletal structure was studied from a transparent preparation, stained with alizarine red. This has confirmed the conclusions based on the external characters. The vertebral column is continued on to the longer limb and is clearly demarcated into vertebrae. The vertebra at the base of the fork is bifid, the branches entering into the limbs of the fork. The branch which enters the shorter right limb provides the skeleton of the accessory limb and is not divided into vertebrae. Its basal one-third is bulky and the distal two-thirds slender. A typical caudal vertebra has two transverse processes placed exactly at the middle. The accessory skeleton starts from the middle of the vertebra where the transverse process is usually seen and thus appears to be the modified and enlarged transverse process. This seems probable, because the corresponding transverse process, though degenerated, is visible on the other side.

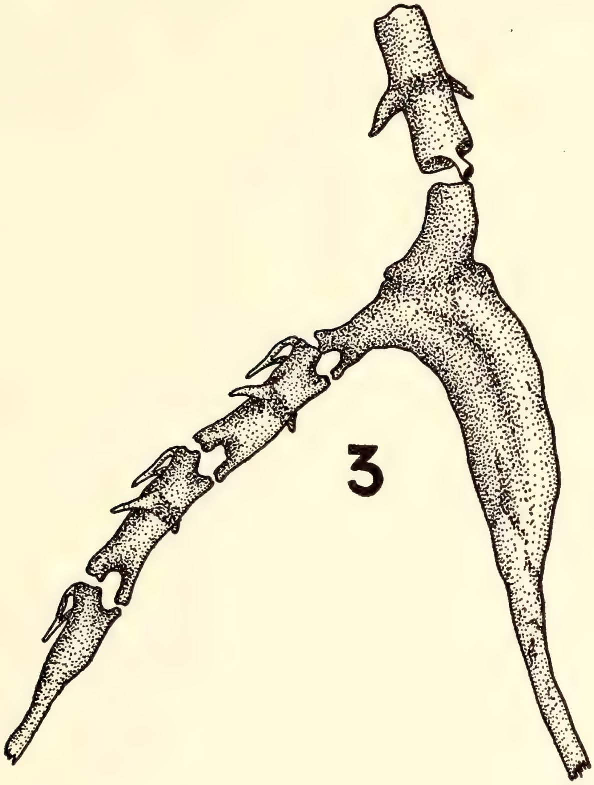


1. Tip of tail (dorsal view).



2. Tip of tail (ventral view).

According to Deraniyagala (*Ceylon J. Sci.* **13**: 291) 'the new tail regenerates only the chorda without the vertebrae' and the 'additional tails arise as regenerations of wounds which fail to break off the original'. In the light of this observation, it appears that in the present case the tail sustained two injuries. One of the injuries affected the tail exactly at the middle of a vertebra and this resulted in the growth of an additional limb. The other injury broke off the tip of the tail and a new one was regenerated as a continuation of the original. This is evident since the tip of the longer limb is exactly like the shorter limb, devoid of vertebrae, dorsal scutes and ventral scales.



3. Caudal skeleton (dorsal view).

Marine Biological Laboratory,
Trivandrum,
May 21, 1958.

N. KRISHNA PILLAI

23. RAT-SNAKES 'MATING'

Motoring down our ghat road I came across two rat-snakes (dhamans) as tightly coiled round each other as a thick rope. On the approach of my car the 'snake-rope' shot up two separate heads, which stared at us, then lowered and the whole then wriggled to a culvert and went down a hole in the culvert wall just as a single snake would—perfect dual control.

DUPABURRAY BUNGALOW,
ATTIKAN P.O.,
VIA MYSORE, SOUTH INDIA,
February 4, 1958.

R. C. MORRIS

[At page 174 of the last number of the *Journal* we have commented on a similar incident reported by Mr. K. R. Sethna.—EDS.]

24. ON A COLLECTION OF FISH FROM DELHI STATE

The study of the fish fauna of Delhi State was undertaken during 1949 at the suggestion of the late Dr. S. L. Hora. Collections were made from all over the State, and the list of species given here may be regarded as being fairly representative of the fish fauna of the State.

PHYSICAL FEATURES

Delhi State is surrounded by Bulandshahr and Meerut districts of Uttar Pradesh on the east, and the Punjab districts of Gurgaon and Rohtak on the south and the north-west respectively. Though situated at a higher altitude of about 709 ft. above sea-level, it is essentially a plateau with an area of 574 square miles. The only river supplying water to this State is the Jumna, which flows along its eastern boundary. Delhi is criss-crossed by irrigation canals bringing water from the Jumna to the agricultural land, village tanks, and ponds.

Jumna River originates in the western Himalayas, 20,720 ft. above sea-level. It flows through Punjab, Delhi, and Uttar Pradesh to meet the Ganges at Allahabad. The level falls by 5,000 ft. in the first 20 miles of its course and 4,500 ft. more before it comes out of its gorge at Faizabad, a distance of about 100 miles from its source. By the time it reaches Delhi, the level falls by another 900 ft. and it becomes a broad river. The differences in its width during summer and winter are very great. During the monsoon months of July and August it is a vast stretch of water about half a mile across, but in the winter months of December and January it dwindles to a small stream with only knee-deep water at places. During the monsoon months some of the hill-stream species are washed down the river and are available at Delhi and all such species collected locally are also included in the list.

Delhi State has an average annual rainfall of only 26.24 inches, on account of which many of the ponds and tanks contain very little water for the greater part of the year. This is a big handicap for the development of fisheries in the State.

List of Species

The classification followed is mainly the one proposed by L. S. Berg (1940). Local names are also indicated wherever available.

Family **Cyprinidae**

1. *Labeo rohita* (Hamilton)	*Rohu*
2. *Labeo calbasu* (Hamilton)	*Kalbons*
3. *Labeo gonius* (Hamilton)	*Kurchia*
4. *Labeo dero* (Hamilton)	*Chilwa*
5. *Labeo pangusia* (Hamilton)	
6. *Cirrhina mrigala* (Hamilton)	*Mirgal, Narain*
7. *Cirrhina reba* (Hamilton)	*Raia, Suni*
8. *Catla catla* (Hamilton)	*Katla*
9. *Barbus* (*Tor*) *tor* (Hamilton)	*Mahaseer, Raja*
10. *Puntius sarana* Hamilton	*Puti*
11. *Puntius sophore* Hamilton	*Bhur, Puti*
12. *Puntius conchonius* Hamilton	*Puti*
13. *Puntius ticto* Hamilton	*Puti*
14. *Puntius punjabensis* Day	
15. *Crossocheilus latius punjabensis* Mukerji	
16. *Garra gotyla* (Gray)	
17. *Amblypharyngodon mola* (Hamilton)	*Meluwa*
18. *Aspidoparia morar* (Hamilton)	*Moraki*
19. *Barilius vagra* Hamilton	
20. *Rohtee cotio* (Hamilton)	*Chanda*

Sub-family RASBORINAE

21. *Esomus danricus* (Hamilton)	*Mola*

Sub-family ABRAMIDINAE

22. *Chela bacaila* (Hamilton)	*Chela*
23. *Laubuca atpar* (Hamilton)	

Sub-family PSILORHYNCHINI

[Family Psilorhynchidae of Hora (1925)]

24. *Psilorhynchus balitora* (Hamilton)

Family **Cobitidae**

25. *Nemachilus corica* (Hamilton)
26. *Nemachilus montanus* (McClell.)
27. *Nemachilus zonatus* (McClell.)

Sub-family BOTINI

28. *Botia lohachata* Chaudhuri ... *Billi*

Family **Siluridae**

29. *Wallago attu* (Bloch & Schneider) *Malli*
30. *Ompok bimaculatus* (Bloch) ... *Pabda*
31. *Ailia coila* (Hamilton) ... *Basmati*

Family **Bagridae**

32. *Mystus (Osteobagrus) seenghala* (Sykes) ... *Singhara*
33. *Mystus (Mystus) cavasius* (Hamilton) ... *Tengra*
34. *Mystus (Mystus) tengara* (Hamilton) ... „
35. *Mystus (Mystus) aor* (Hamilton) „
36. *Rita rita* (Hamilton) ... *Rita, Ghegra, Khagga*

Family **Schilbeidae**

37. *Eutropiichthys vacha* (Hamilton) *Bacha*
38. *Silonia silondia* (Hamilton) ... *Silond*
39. *Clupisoma garua* (Hamilton) ... *Bacha*

Family **Saccobranchidae**

40. *Heteropneustes fossilis* (Bloch) ... *Singi*

Family **Sisoridae**

41. *Bagarius bagarius* (Hamilton) ... *Gonch*
42. *Gagata cenia* (Hamilton)
43. *Nangra punctata* Day
44. *Glyptothorax telchitta* (Hamilton)
45. *Sisor rhabdophorus* Hamilton

Family **Ophiocephalidae (Ophicephalidae)**

46. *Channa punctatus* (Bloch) ... *Souli*
47. *Channa striatus* (Bloch) ... *Soula, Souli*

48. *Channa marulius* (Hamilton) ...	*Shai*
49. *Channa gachua* (Hamilton) ...	*Shouli*

Family **Gobiidae**

50. *Glossogobius giuris* (Hamilton)	*Bhelua*

Family **Centropomidae (Ambassidae)**

51. *Ambassis nama* (Hamilton) ...	*Chanda*
52. *Ambassis ranga* (Hamilton) ...	„

Family **Anabantidae**

53. *Colisa fasciatus* Bloch & Schneider	*Kharda*

Family **Mugilidae**

54. *Mugil corsula* Hamilton ...	*Andowari*
55. *Mugil cascasia* Hamilton	

Family **Mastacembelidae**

56. *Mastacembelus armatus* (Lacépède) ...	*Bam*
57. *Rhynchobdella aculeata* (Bloch)	*Giluwa*

Family **Notopteridae**

58. *Notopterus chitala* (Hamilton) ...	*Chital, Pari*
59. *Notopterus notopterus* (Pallas) ...	*Pholee, Mo*

Family **Clupeidae**

Sub-family CLUPEINI

60. *Gadusia chapra* (Hamilton) ...	*Khuri*

Family **Belonidae (Xenentodontidae)**

61. *Xenentodon cancila* (Hamilton)	*Chonchwali*

Family **Amphipnoidae**

62. *Amphipnous cuchia* (Hamilton)	*Bam*

IMPORTED VARIETIES

Besides the sixty-two species listed above, the following species of freshwater, estuarine, and marine fishes are imported from outside Delhi and are available in the fish-markets:

1. *Hilsa ilisha* (Hamilton) ...	*Ilish, Hilsa*
2. *Clarias batractus* (*Linnaeus*) ...	*Magur*
3. *Nandus nandus* (Hamilton)	
4. *Eleutheronema tetradactylus* (Shaw) ...	*Salmon*
5. *Pampus argenteus* (Euphrasin) ...	*Pomfret*

6.	*Scomber microlepidotus* Rüppell	*Mackerel*
7.	*Lates calcarifer* (Bloch) ...	***Bhetki***
8.	*Cynoglossus* sp. ...	*Chepti*

REMARKS

In several locally available species slight variations in body proportions, number of fin-rays, scale counts, and coloration have been noticed, which along with their description, bionomics, and ecology are being published in the form of a separate handbook.

ACKNOWLEDGEMENTS

I am grateful to Dr. M. L. Bhatia, Professor and Head of the Department of Zoology, University of Delhi, and to the late Dr. S. L. Hora for their constant encouragement and guidance during the progress of this work. My sincere thanks are due to Mr. A. G. K. Menon of the Zoological Survey of India for checking up my identifications. My thanks are also due to my colleague Mr. H. L. Sarkar and to my friend Dr. B. G. Kapoor for giving me specimens of *Barilius vagra* and *Sisor rhabdophorus* from their collections.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF DELHI,
DELHI,
October 31, 1957.

N. N. MAJUMDAR

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25. PARASITISM OF *OPHICEPHALUS GACHUA* HAMILTON BY THE COPEPOD *ARGULUS INDICUS* WEBER

Max Weber (1892) originally described the female of *Argulus indicus* Weber from the east coast of Java. The male of this species was later described by Wilson (1926, 1944) from Bangkok (Thailand).

The above species was reported from India for the first time by Ramkrishna (1952) who in his paper referred that the collection of the parasites was previously made by S. C. Bough from the skin of *Ophicephalus punctatus* Bloch from Champahati, a village 15 miles south of Sealdah Station, West Bengal.

On 7 April 1956, during the survey of the fish fauna of Gokalpur Lake, Jabalpur, M.P., 2 specimens of *Ophicephalus gachua* Hamilton were collected from a small piece of fresh water which later runs to join the lake proper. Both the specimens of *Ophicephalus gachua* were heavily infested with *Argulus* all over the body on all sides and on the fins. The number of parasites collected from both the fishes was 26. The number of male specimens was 17 and the rest were females. On identification these parasites were found to be *Argulus indicus* Weber.

It would appear that *Argulus indicus* is not strictly host specific, but is ectoparasitic on different species of Indian murrels.

The author's thanks are due to Dr. B. S. Chauhan of the Zoological Survey of India for the specific identification of the parasites and for his helpful suggestions.

DEPT. OF ZOOLOGY,
MAHAKOSHAL MAHAVIDYALAYA,
JABALPUR, M.P.,
June 20, 1957.

R. B. MALAVIYA

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26. PELAGIC SWARMING OF *POLYOPHTHALMUS* (FAMILY OPHELIIDAE—POLYCHAETA)[1]

(*With one text-figure*)

While making certain observations relating to the experimental *kelong*[2] fishing operations being conducted at this research station, I came across an interesting phenomenon which seems worthy of record. Surface collections made in the Gulf of Mannar (approximately at lat. 9° 16′ N. and long. 79° 08′ E.) during February and March 1958 with the help of a hand net after sunset under a 200 c.p. gas lamp suspended about half a metre above the water surface showed a varying number of small Opheliid worms on different nights. These collections were primarily intended for other purposes and, as no special effort was made to collect the polychaetes in particular, it is possible that at the time of collection these swift moving worms were present in larger numbers than were actually represented in the hauls. The phenomenon was observed at a distance of about 365 metres from the coast, where the bottom is characterised by loose sand and is surrounded by extensive coral and algal beds. During the highest tide the water is about 4 metres deep at this place, although during occasions when the swarming was noticed the water level had never attained its maximum for the night.

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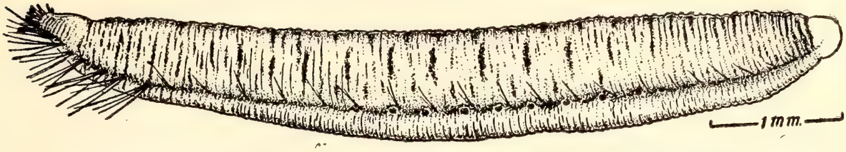
[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

[2] The 'Kelong' used in this case consists of a kind of lift net in conjunction with a light as lure and operated at night from a raised platform on the sea. Further descriptions of this will appear elsewhere. The author wishes to record here his appreciation of the help rendered by Shri D. Edward Chellappa who is conducting the fishing operations and who was responsible for obtaining the night collections.

The Opheliid is identified as a juvenile *Polyophthalmus pictus* (Djuardin) and a slightly contracted specimen is shown in the figure. When freshly caught these worms swim about vigorously with a wriggling or more often a darting movement characteristic of many of the adult Opheliids. The length of the specimens ranges from 7 to 10 mm. with 27 setigerous segments. Body segmentation is not clearly marked off but there are annulations more numerous than the segments themselves. The body is pigmented by brown spots in the form of close rings which are prominent in the anterior and posterior regions. But this pattern is slightly variable with the pigment rings often losing their continuity and appearing in bands or patches in the middle and dorsal regions of the body. The head is not pigmented and the prostomium is short and round at its tip unlike many other Opheliids which show a pointed conical snout. The ventral groove is relatively more prominent than the ventrolateral ones. About 12 anal papillae are present fringing the margin of a short anal funnel. Lateral gills are absent throughout. 2 or 3 submerged cephalic eyes and about 10 lateral eye spots starting from the 7th segment are present. The parapodia in these specimens do not seem to have attained the adult biramous structure described for the genus and possess two or three simple capillary setae in each parapodium. However, in the last seven segments of the body the capillary bristles are highly elongated as shown in the figure with 5-7 setae in each foot. Those of the last segment project well beyond the anal papillae. Similar enlongated posterior bristles in the newly metamorphosed larvae have been noticed in *Ophelia* (Wilson, 1948) and in *Thoracophelia* (Dales, 1952). While discussing the significance of this character Wilson has also pointed out that this is a feature of the young and mature sexual individuals of *Polyophthalmus*. He has also noticed a slight correlation between the prolongation of these posterior bristles and the type of bottom soil inhabited by the worms, for the finer the soil the shorter are the posterior bristles. However, considering the pelagic swarming habit of these juvenile worms one is inclined to regard this phenomenon as an adaptation for swimming during its pelagic phase.



Text-fig. A juvenile specimen of *Polyophthalmus pictus* (Djuardin).

The family Opheliidae includes worms with a markedly localised distribution inhabiting only a fairly narrow range in grade of bottom soil of the intertidal areas or at some depth in the sea. They are not known to have an atokous phase and do not usually occur in plankton when once they have taken to a life at the bottom after the metamorphosis of the larvae. There seem to exist only very few records of observations of these worms assuming a pelagic phase in their life besides the remarks by Fauvel (1927) and Wilson (1948) that *Polyophthalmus* becomes pelagic at night during its period of sexual maturity. Our knowledge of Indian Opheliidae itself is meagre. Fauvel's records (1956) show that Opheliid worms are known to occur from Ceylon, Pamban, Krusadai Island, and Kilakkarai in the Gulf of Mannar region. Recently I obtained adults of *Ammotrypane aulogaster* from the muddy bottom in the Mandapam Dockyard area and adjacent localities[1], and *Armandia* species from the sandy intertidal zones in Krusadai Island and also opposite the Fisheries Station Campus. With the occurrence of a varied and suitable type of substratum in these regions it is very likely that the different Opheliids inhabit other localities as well around the spot where the swarming phenomenon was noticed at present.

Apart from the classical examples of periodic swarming of the several errant polychaetes and their larvae which have been critically analysed and reviewed by Korringa (1947), the occurrence of sedentary forms such as the Scalibregmids in surface collections has been recorded by Clark (1952-53). Earlier, Meek and Storson (1924) have mentioned a pelagic phase in the life of the bottom living *Arenicola marina.* Korringa's review indicates that the swarming phenomenon exhibited by most such polychaetes more or less during definite periods is associated with maturity and changes in the lunar cycle. The worms taking part in the swarming have thus been found to be sexually ripe. The few observations made at present do not warrant any generalisation of the factors influencing the rising of *Polyophthalmus* to the surface at night. Sexual play may have to be ruled out in this particular instance as the specimens obtained were all immature. The migrating Scalibremids observed by Clark (1952-53) were also immature as in this case. The period of sexual maturity of Opheliids in our waters is not known except for my observations on *Armandia Leptocirris* (unpublished) which become sexually ripe in February-March. The intervals of the swarming behaviour observed so far do not throw light on any possible correlation with the lunar phase although it may be mentioned that the worms appeared in surface collections between the full moon and the last quarter, on the new moon night, and again just before the first quarter with a maximum during that time. Similarly, factors such as the surface temperature and the weather conditions did not reveal any abnormal changes from the usual conditions prevailing in the Gulf during the season. The swarming of these worms under the light seems to indicate some kind of photopositive reaction although there is no conclusive evidence of this. However, this might be of some interest in view of the negative phototropism observed in the larvae of *Ophelia bicornis* by Wilson (1948). As regards the association of these swarming worms with other animals, the general composition of the organisms in each collection varied, sometimes considerably. Swarms of Calanoids, Cumaceans, Decapod larvae, or Ostracods were obtained along with the polychaetes on different nights.

---

[1] Thanks are due to Dr. R. Raghu Prasad for placing the bottom samples from the Gulf of Mannar at the disposal of the author in this connection.

CENTRAL MARINE FISHERIES RESEARCH STATION,
MANDAPAM CAMP,
S. INDIA,
March 28, 1958.

P. R. S. TAMPI

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27. A LIST OF BUTTERFLIES FOUND ON DATE PALMS TAPPED FOR TODDY

In November last year I had an opportunity to watch for a few days a number of butterflies disporting on and around a date palm tapped for toddy. They were attracted to the palm, no doubt, by the smelly sap which dripped down the trunk and also fell on the ground at the base. The butterflies settled wherever the sap fell and sipped for varying lengths of time throughout the day. Between sips they left the tree and basked on the bushes near it or flew aimlessly around or gave chase to one another for short distances. Curiously enough, they showed no ill effect of toddy in spite of their repeated indulgence in it all through the day.

I give below a list of the butterflies sipping on the palm as found by me during those few days of November:

I. Satyrids

- A species of Bushbrown (*Mycalesis*)
- Bamboo Treebrown (*Lethe europa*)
- Nigger (*Orsotrioena medus*)
- Common Evening Brown (*Melanitis leda*)
- Common Palmfly (*Elymnias hypermnestra*) ♂ ♀
- Spotted Palmfly (*Elymnias malelas*) ♀

II. Nymphalids

- Tawny Rajah (*Charaxes polyxena*) ♀
- Clipper (*Parthenos sylvia*)
- Knight (*Lebedea martha*)
- Commander (*Limenitis procris*)
- Painted Courtesan (*Euripus consimilis*) ♂
- Colour Sergeant (*Pantoporia nefte*) ♂ ♀
- Common Sergeant (*Pantoporia perius*)
- Common Sailor (*Neptis hylas*)
- Baron (*Euthalia garuda*) ♂ ♀
- Gaudy Baron (*Euthalia lubentina*) ♀
- Grey Count (*Euthalia lepidea*)
- Peacock Pansy (*Precis almana*)
- Lemon Pansy (*Precis lemonias*)
- Yellow Pansy (*Precis hierta*)
- Grey Pansy (*Precis atlites*)

(Sex differentiation by sight)

A fuller account of the butterflies is published in the *Journal of the Bengal Natural History Society,* Darjeeling, April 1958.

Sonapur Tea Estate,
Sonapur P.O.,
Dt. Kamrup (Assam),
May 28, 1958.

AJOY SHANKAR BHADURI

28. INDIVIDUAL HOST DISCRIMINATION BY BLOOD-SUCKING INSECTS

In the summer of 1957, during a world flight, I spent nine days in India. On the morning of July 21 Mr. Sálim Ali, Mr. Humayun Abdulali, and I were observing birds near Funnel Hill about twenty miles north-east of Bombay. Mr. Abdulali and I walked together through the woods for about half an hour. When we emerged, Mr. Abdulali's head, face, neck, and arms were covered with many large swellings from insect bites, mainly mosquito, whereas I showed no similar symptoms. We both were hatless and wore short-sleeved, open-necked shirts. I can offer no explanation of the preference shown. Is it related to the ecology of the insects, whatever they were? Did I have some kind of immunity which my companion did not have? Perhaps some experiments would have to be made on the spot to reach any exact conclusions.

Brooks School,
North Andover, Mass., U.S.A.,
March 8, 1958.

OSCAR M. ROOT

[This note was referred to a medical friend and his reply reads in part:

'. . . the reaction to mosquito bites is not synonymous with having been bitten by mosquitoes. While there is no doubt, from careful field studies which have been done, that different persons are attractive to different degrees, it is also well known that some people have a strong local reaction to bites while others do not.'

We hope to have a more detailed note on this interesting subject later.—Eds.]

29. *PARAGREWIA* GAGNEP. EX SESHAGIRI RAO SYNONYMOUS WITH *LEPTONYCHIA* TURCZ.

During 1947, while studying Indo-Burmese species of *Grewia,* a few doubtful sheets belonging to the Calcutta and Madras Herbaria were well matched with the description and diagrams of *Paragrewia* *poilanei* just then published by Gagnepain in SUPPLEMENT A LA FLORE GENERALE DE L'INDOCHINE I, 1945, and an account of them was given under this name by the writer (*JBNHS* **51**: 671, 1953 and **52**: 190, 1954).

Recently, while working on similar doubtful sheets kept along with *Grewia* specimens at the Herbarium of the Royal Botanic Garden, Edinburgh, the writer came across a few more species similar to *Paragrewia* collected from India and Central Africa, and after proper dissection and study all of them, including the so-called *Paragrewia poilanei* from Burma and India (*JBNHS* **51**: 672, 1953), have turned out to be species of *Leptonychia* Turcz. (Sterculiaceae). After careful study of the Indian material of *Leptonychia* and the so-called *Paragrewia* at Edinburgh, Kew, and British Museum Herbaria, it has been found that *Paragrewia poilanei* is nothing but *Leptonychia moacurroides* Bedd. Subsequently, a holotype and two isotypes of *Paragrewia poilanei* Gagnep. have been studied at the Paris Herbarium where there are three sheets of *Poilane* 31768. One of them with Poilane's original label with details of locality and Gagnepain's diagrams of floral dissections which have been actually reproduced in Gagnepain's paper (loc. cit., 1945) is considered to be the holotype. Gagnepain's floral dissections kept in an envelope attached to the holotype show, on careful examination, appendages and staminodes along with the staminal tube, features which have been completely omitted by him in his description and diagrams. The writer is fully convinced that the type material is nothing but *Leptonychia moacurroides* Bedd. Therefore, the new genus *Paragrewia* together with its type species *Paragrewia poilanei* cannot stand. The synonymy of the species is as follows:

Leptonychia moacurroides Bedd. Fl. Sylvatica, 1, t. 114 (1871).
Syn.: *Grewia acuminata* Bedd. in Madras J. Sc. ser. 3, 1: 38, 1864 et in Trans. Linn. Soc. Lond. 25: 210, 1865—non Juss. (1804).
Leptonychia acuminata (Bedd.) Burret in Notizbl. Bot. Gart. Mus. Berlin, 9: 727, 1926—non Mast. (1874).
Paragrewia poilanei Gagnep. in suppl. Fl. Gen. Indo-Chine, 1, (1945); Seshagiri Rao in *JBNHS,* **51**: 671, 1953 & **52**: 190, 1954.

My grateful thanks are due to Mr. B. L. Burtt, Royal Botanic Garden, Edinburgh, for his kind suggestions during the study.

BOTANICAL SURVEY OF INDIA,
SHILLONG,
March 15, 1958.

ROLLA SESHAGIRI RAO

30. ON THE IDENTITY OF *KERSTANIA* RECH. F.

(*With one map*)

The genus *Kerstania* Rech. f. has been described recently (Rechinger f., 1957) from Afghanistan, based on *K. nuristanica* Rech. f. It is said to be related to *Hosackia* Dougl. ex Benth. The description of the genus is accompanied by good illustrations (Rechinger f., 1957, t. 8, 9) and my observations are entirely based on them.

A critical study of these illustrations has revealed that *Kerstania nuristanica* Rech. f. is the same as *Astragalus hosackioides* (Royle ex Benth.) Benth. This species was originally described by Bentham (1835) in the genus *Podolotus* Royle ex Benth. and at that time he had clearly pointed out its affinity with the totally American genus *Hosackia* Dougl. ex Benth. However later in 1865 (Bentham, 1865) he transferred it to the genus *Astragalus*. The same treatment has been maintained by Baker (1876).

In Hooker f., FLORA OF BRITISH INDIA, Vol. 2, this taxon has only been reported from Kumaon and Garhwal. However, while revising the genus *Astragalus* from W. Pakistan and NW. Himalaya, it has come to light that this taxon is more widely distributed than was hitherto known and it extends to Kashmir, E. Punjab, W. Punjab, and N.W.F. Province. The present recognition of *K. nuristanica* Rech. f. as *A. hosackioides* (Royle ex Benth.) Benth. shows that it is present in Afghanistan (Nuristan) also (see map).

As stated earlier this taxon is presently placed in the genus *Astragalus, Podolotus* being recognised as a subgenus (Bentham, 1865; Baker, 1876). Bentham has recognised only two species in this subgenus, namely *A. hosackioides* (Royle ex Benth.) Benth. and *A. lotoides* Lam. (*A. sinicus* L.). Even if it is thought desirable to recognise a separate genus for the taxon under discussion, *Podolotus* Royle ex Benth. has priority over *Kerstania* Rech. f., which must be reduced to synonymy.

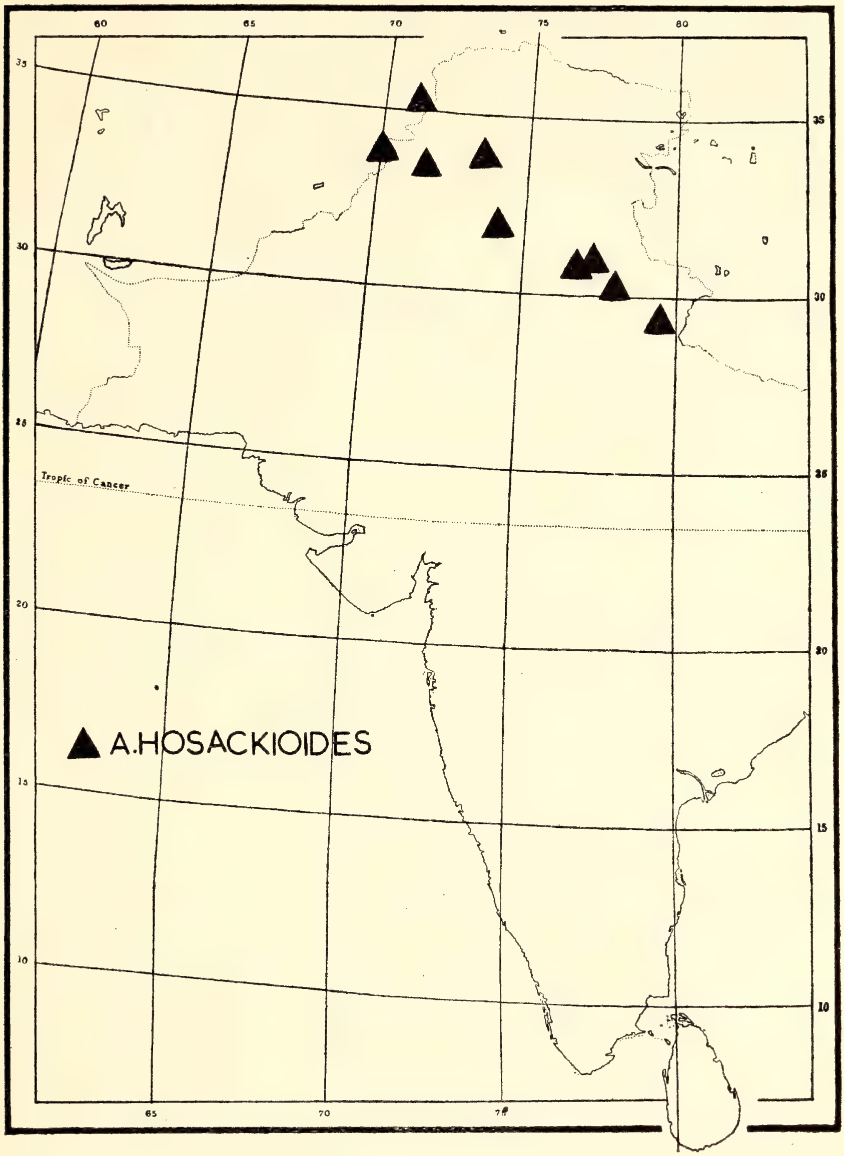
The correct specific epithet and the synonymy is as follows:

Astragalus hosackioides (Royle ex Benth.) Benth. in Benth. et Hooker f. Gen. Pl. 1 (2): 507. 1865.

Kerstania nuristanica Rech. f. in Biol. Skr. 9 (3): 19, 1957.

The specimens observed on which the attached map is based are as follows:

Punjab (East and West): Mount Krol, 4,000 ft., Drummond 21918 (K); (G); Murree, Lawrence Road, June 1915, Saunders (K); Banni, Murree Hills, 6,000 ft., B.O. Coventry (K); Chamba Shali, 8,000 ft., Collet 157 (K); Simla-Kalka, 4,000 ft., Drummond 24771 (K); Simla, Suni 3,000 ft., Watt 9740 (E).


60
65
70
75
80
35
30
25
20
15
10
Tropic of Cancer
▲ A.HOSACKIOIDES

NW.F. Province: Kohat, 3,000 ft., Drummond 21915 (K); Khil Tangi, Kurram Valley, Harsukh 14982 (K).

Kashmir: Nakial, Poonch, 6,000 ft., A. Rashid and R. R. Stewart 25853 (RAW).

Kumaon and Garhwal: Nainital, 7,000 ft., Strachey and Winterbottom (K); Nainital, 6,800 ft., Strachey and Winterbottom (K); (BM); Nainital, Thomson 586 (K); (BM).

[For the abbreviations of the herbaria referred above, I have followed Lanjouw and Stafleu (1956)].

ACKNOWLEDGEMENTS

To the authorities of the following herbaria my thanks are due for the herbarium and the library facilities: Royal Botanic Gardens, Kew; British Museum (Natural History), London; Royal Botanic Gardens, Edinburgh; Conservatoire et Jardin botaniques, Geneva. I am also indebted to Dr. R. R. Stewart, Principal, Gordon College, Rawalpindi, for kindly sending the specimens on loan.

C/O THE HERBARIUM,
ROYAL BOTANIC GARDENS,
KEW, RICHMOND,
SURREY, ENGLAND,
April 30, 1958.

SYED IRTIFAQ ALI

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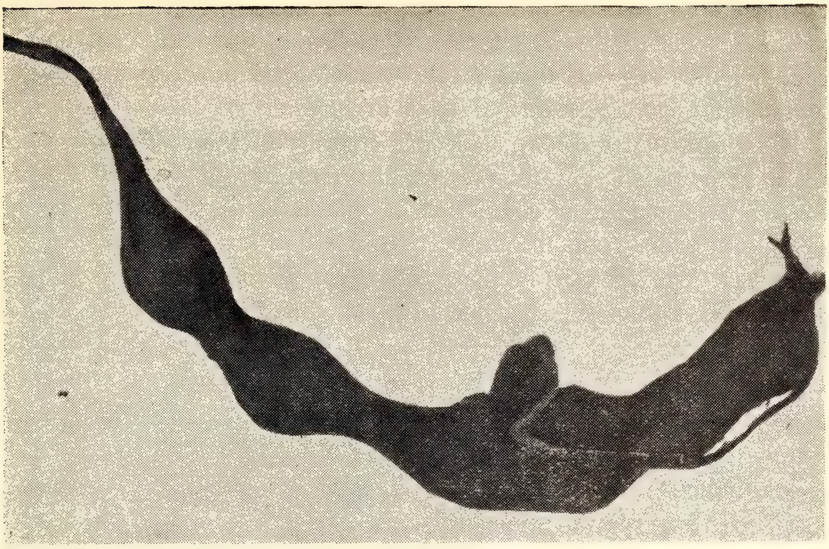
31. OBSERVATION OF VIVIPARY IN *ERYTHRINA INDICA* LAMK.

(*With a photo*)

Viviparous germination is common in most of the mangrove plants like *Rhizophora, Bruguiera, Ceriops, Kandelia,* etc., where it occurs on account of special adaptation to the surroundings and also for a quick fixation of the seedlings in their usual muddy habitat.

Goebel (2) has reported cases of vivipary in Hepaticae, Musci and Filicinae of moist habit, where spores germinate within the sporangium without any resting period. He also states that Filicinae members when grown in dry region produce spores which germinate only after a resting period.



Photograph showing the germination of seeds in a pod

Viviparous germination is also known amongst non-mangrove plants like *Mangifera indica* L., *Artocarpus integrifolia* L., some species of Cucurbitaceae, Rutaceae, Gramineae and Cactaceae. Khan (3) reported vivipary in *Moringa* and tried to classify viviparous forms. Mani (4) observed 8 healthy seedlings inside the fruit of *Pyrus malus.* Venkataraman (6) noted that in *Carica papaya* seeds have no dormant period and the cotyledons had turned green while still inside the fruit. Srivastava and Williamson (5) have recently published a note on the germination of seeds inside the fruit, in which they have referred to viviparous generation in *Cucurbita maxima* L. Khan (3) has suggested the classification of this phenomenon of vivipary under two groups, true and spurious, depending upon the direct and indirect supply of food and water from the parent plant.

While collecting plants for undergraduate students of our Institute on 3 August 1957 it was noticed that many of the roadside trees of *Erythrina indica* Lamk., belonging to Papilionaceae, near Ghodbunder nearly 25 miles north of Bombay, had their pods fully matured and turned blackish. Some of them were open and about to disperse their seeds. Among these many seeds were in different stages of germination while still on the parent plants. It was further observed that the pods in which the seeds were germinating were turned in the upward direction while on the trees, as if to give support to these germinating seeds. In some cases the seedlings were developed up to 3-4 inches. The specimens were brought to the laboratory for photographing and for further examination.

On looking around these trees, it was noticed that many of the seedlings, some of them of considerable length, were scattered on the ground, indicating that these must have dropped down to the ground from older pods either due to wind or birds.

It appears that the normal dormant period of the seeds is lessened and a stimulus for germination on the trees is obtained by favourable climatic and other conditions of humid air and constant drizzling of rain water from the upper branches and leaves.

It was further observed that seeds were germinating only in pods in which dust from the roadside had accumulated, and this was aided by the texture of the dried fruit coat, the lately developed upward curvature of the pod, and its cracking along the upper suture, resulting in the formation of a partly curved boat-shaped structure and heavy dampness due to season.

As indicated by Khan (3) this type of germination could be classified as a spurious vivipary, wherein the seedlings though still attached to the parent plants do not get their nourishment and water supply from the latter.

We have been prompted to write this note seeing that Blatter and Millard (1) in the first edition, and Stearn (1) in the second edition of SOME BEAUTIFUL INDIAN TREES, whilst describing the plant and all its parts in full, do not mention vivipary as observed by them; this note thus supplements an otherwise interesting and fairly complete description of *Erythrina indica* Lamk.

Finally, we express our sincere thanks to Rev. Fr. H. Santapau, S.J., Ph.D. (Lond.), Director of the Biology Department, St. Xavier's College, Bombay, for his valuable suggestions and for critically going through the manuscript.

BOTANY DEPARTMENT,
INSTITUTE OF SCIENCE,
MAYO ROAD, FORT,
BOMBAY 1,
May 8, 1958.

S. S. KELKAR
B. S. NAVALKAR

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32. *SERICOCALYX SCABER* (NEES) BREMEK.

(*With a plate*)

A few months ago the authors of this note were keen on getting information on this plant, which had been collected for the first time from Baroda on 7 March 1957. The identification proved somewhat troublesome.

At first sight the plant might be confused with *Ruellia* particularly on account of the twisting of the corolla; but other characters suggested *Strobilanthes*, among these the number of stamens, usually 4, the nature of the corolla tube, and the number of seeds. Two pressed specimens were sent to Father H. Santapau of St. Xavier's College, Bombay, for determination. He remarked: 'The plant is a stranger in our flora; it is definitely *Ruellia* genus, but I have no means of coming to the species since none of my monographs on Acanthaceae mentions the plant. The specimens will have to be sent to an international Herbarium, such as Kew or Harvard's Arnold Arboretum.' Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun, identified it as *Strobilanthes scaber* Nees.

This identification was confirmed by the Director of the Royal Botanic Gardens, Kew, England, who in his letter further states that the specimen is *Sericocalyx scaber* (Nees in Wall.) Bremekamp, Mat. Mon. Strobil. 165 (1944). Syn. *Strobilanthes scaber* Nees in Wall. Pl. As. Rar. 3: 84, 1832.

The nomenclature of the plant is as follows:

Sericocalyx scaber (Nees) Bremek. in Verh. Nederl. Akad. Wet. II, 41 (1): 163, 1944.

Strobilanthes scaber Nees in Wall. Pl. As. Rar. 3: 84, 1832; Bot. Reg. 27: t. 32, 1841; Fl. Brit. Ind. 4: 446.

Ruellia scabra Wall. Cat. 2393, nom. nud.; non Cat. 2377.

Ruellia aspera Nees in DC. Prodr. 11: 147, quoad spec. Bengal.

Distribution: Burma, N. and E. India; elsewhere cultivated.

DESCRIPTION

Stems 30-90 cm. high, pubescent or hairy upwards; leaves 12×5 cm., narrowed at the base, crenate at the margins, coarsely scabrid to subhispid or at times nearly glabrous, hard; nerves 7-8 pairs; petioles 2 cm. long. *Inflorescence* in spikes 2.5-5 cm. long, hairy; bracts 2.5×0.5 cm., obtusely acuminate, green; bracteoles 6 mm. long, linear, or oblong; *calyx* 6-8 mm. long, divided nearly to the base, the segments linear, pubescent; *corolla* symmetric or nearly so, glabrous, base cylindric, about as long as the ventricose portion, lobes rounded. *Stamens* included, the filaments hairy towards the base. *Ovary* glandular at the apex, always 4-ovulate; *style* nearly glabrous; *capsule* 12-14 mm. long, 4-seeded; *seeds* about 2 mm. diam., discoid, with numerous fine hairs near the edges, the hairs being hygroscopic and expanding when wet; areoles very large, glabrous. According to Thwaites and Beddome the plant is found in Ceylon, but only under cultivation.

FIELD NOTES

In the field near Baroda we have always recorded this plant as a cultigen, and only from the University Botanic Garden and Sayaji Park, Baroda. We feel somewhat dissatisfied with the descriptions of the habits and habitat of this plant as given in the literature; in our area it seems to be a rather variable plant. Sometimes it is found along *Lawsonia* hedges (in the grounds of the Faculty of Science), with its divaricate branches spreading; in front of the buildings of the Faculty of Arts the plant is utilised by our malis for making borders from small cuttings taken from any individual plant. There is considerable difference in the plants collected from Sayaji Park; here it is a perennial shrub, up to 2 m. high, rather bushy and vigorous in growth; the flowers are yellow with a brownish purple tinge in the tube; the leaves are larger, the spikes longer, the bracts larger than in the normal variety. In this park the plant seems to prefer shaded spots, or perhaps it was planted there in the first instance and has developed some abnormal size and habit.

From the scanty data collected to the present no conclusion can be drawn; but from past records it is clear that the plant is a new record for Baroda, and further that it is a rare species both in Baroda and in Bombay State.

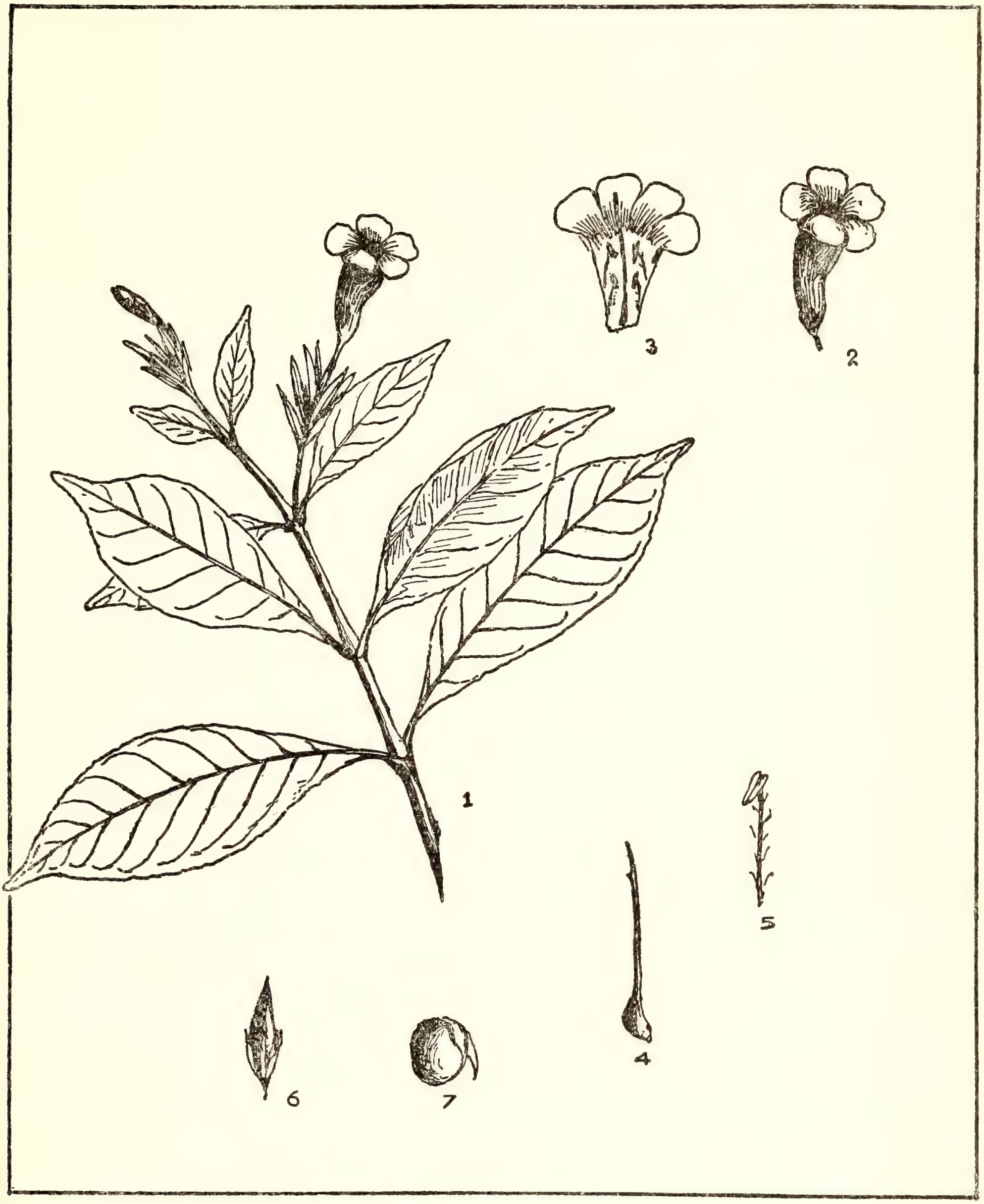
Flowering: Late February to early April; *Fruiting*: Mid-April to June.

Embryological work on this plant has been carried out by Miss K. B. Ambegaonkar in our University; and it is mainly due to her enthusiasm for the collection and identification of materials of the family Acanthaceae that the authors were moved to collect the present material and write this note to clear up the systematic position of the plant.

BOTANY DEPARTMENT,
M.S. UNIVERSITY,
BARODA,
May 8, 1958.

V. G. PHATAK
B. B. JOSHI

[According to Bremekamp, op. cit. p. 57, the genus *Sericocalyx* extends through south China, Indo-China, Sumatra, Java, Celebes,



Sericocalyx scaber (Nees in Wall.)
Bremek.

(1) Entire branch, (2) Flower, (3) St. didynamus (dissected flower)
(4) Ovary, (5) Stamen, (6) Capsule, (7) Seed.

Sunda Islands; elsewhere only under cultivation or as an escape from cultivation. The species *Sericocalyx scaber* (Nees) Bremek. has been cultivated in many parts in Asia; from Bombay, in addition to the Baroda specimens mentioned in the note, the plant has been recorded from Victoria Gardens, where it has been flowering profusely for a number of years.—EDS.]

33. *COELOGYNE CALCICOLA* KERR IN BURMA

In 1953 I received this orchid from Sinlumkaba in the Kachin State, Lat. 24° 15′ N., Long. 97° 30′ E., alt. 5,000 ft. U, Aung Din, M.A. (Oxon.), silviculturist, Forest Department, Burma, very kindly sent a herbarium specimen to the Royal Botanic Gardens, Kew, where it was identified.

The description from 'Orchids from Laos' (1933 *Journal Siam Society*, Natural History Supplement 9) is quoted below:

'The sepals and petals are creamy white, the lip white with yellow patch on disc and brown ridges. There are two specimens in the Kew Herbarium referable to this species: Forrest 18715, Yunnan, and a cultivated specimen from the Botanic Gardens, Glasnevin, "probably from Siam or Annam, as it is of French origin".'

In 1956, I received this orchid from Mount Victoria in the Chin Hills 21° 15′ N., 93° 55′ E., alt. 10,210 ft., and in 1957 from Nyaunggyo, 19° 33′ N., 94° 50′ E., alt. 3,500 ft. The plants from Nyaunggyo are smaller than the ones from Sinlumkaba and Mount Victoria. This may be due to the lower altitude where they grow, or it may be a small flowered form? They are not thriving in Rangoon.

25 INYA MYAING ROAD,
UNIVERSITY P.O.,
RANGOON,
BURMA,
March 31, 1958.

TUN YIN,
B.C.S. (S.G.), Retd.

34. GROWING SAFFRON IN LUCKNOW

In 1956 a plant collection party from the National Botanic Gardens, Lucknow, collected corms of saffron (*Crocus sativus* Linn.) from Kishtwar and Pampur in Jammu and Kashmir State. The corms were planted in the National Botanic Gardens, Lucknow, in September, in pots filled with leaf mould and soil. Some of the plants produced flowers in the last week of November and first week of December 1956.

Subsequently in 1957 corms ranging from 8-9 cm. in diameter were introduced from Kashmir. They were planted in the third week of October 1957 in pots in the same manner. The plants produced flowers in the second and third weeks of November 1957. The corms obtained from the 1956 crop in the gardens, however, did not produce any flowers in 1957.

It may be seen from the above that *Crocus sativus* Linn. can be grown in Lucknow by importing corms from Kashmir. Corms of 8-9 cm. diameter planted in the second week of October produced flowers within a month. It is intended to continue the experiment on a bigger scale next year.

The author's grateful thanks are due to Prof. K. N. Kaul, Director, National Botanic Gardens, Lucknow, for encouragement and guidance.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
February 25, 1958.

G. S. SRIVASTAVA

Notes and News

A combination of circumstances, happy and sad, has obliged the Society to shift its time-honoured headquarters from the premises of Messrs Phipson and Co., 114 Apollo Street, where its offices and library have been housed since 1885. Owing to serious overcrowding, the extensive and fast-expanding reference collections of mammals, birds, snakes, insects, etc. had to be moved to the Prince of Wales Museum in 1921.

For many years the scientific work of the Society had been seriously hampered, first by the great congestion in the old premises, and later by the fact that the library and research collections were in such widely separated places and thus inconvenient to use. Efforts had been continuous to find a permanent home for the Society where not only would all the necessary facilities be available under one and the same roof, but where adequate working space could be provided for research workers and students, together with a meeting room for members and a well-equipped lecture hall. Negotiations for the sale of Phipson and Company's premises were well advanced, and the imminent prospect of being thrown out on the street prompted the Committee to urge on the Governments of India and Bombay State the pressing need of a permanent home for the Society with its priceless scientific collections and library, if its good work of three-quarters of a century was to continue.

We are happy to announce that the efforts have borne fruit and, thanks to the Central Government, there seems every likelihood of the Society getting a permanent home in the grounds of the Prince of Wales Museum in the near future. Until such time as the new building is up and ready for occupation, it is hoped that the Government of Bombay will be pleased to continue a renewal of the grant which they have made to the Society for the first year to enable it to hire temporary premises and carry on its independent existence.

The Committee have been able to rent adequate premises in 91 Walkeshwar Road, Malabar Hill, (Bombay 6), as from 1st September 1958, but it may be yet a while before the shift is completed and our office can settle down to its normal routine. Some inconvenience to members during this process of moving is inevitable, but it is hoped will be overlooked.

* * * *

The Bombay Natural History Society has been recognised by the University of Bombay as a post-graduate teaching institution for

Field Ornithology. B.Sc. zoology students will henceforth be able to get an M.Sc. degree with research in field ornithology under the guidance of the Society. This is the first occasion where the importance of the field study of birds has been recognized by an Indian university, and it is hoped that students will take advantage of the special facilities which the Society is in a position to offer in this department. Just at present we are fortunate in having at our disposal as teacher and guide Dr. J. H. Crook, a competent researcher from the Maddingley Ornithological Field Station of Cambridge University. Further particulars may be obtained from the Honorary Secretary, 91 Walkeshwar Road, Bombay 6.

* * * *

We are glad to announce that the Rockefeller Foundation has made a grant of $10,000 to the Society to be used during the year 1959 for general operating expenses and the employment of personnel in furtherance of its expansion programme in the new premises.

This is a handsome tribute to the sterling work of the Society in the cause of Indian Natural History, carried out under difficulties and with restricted finances. The Society is grateful to the Foundation as much for its munificence as for this appreciation of its efforts and achievements.

* * * *

In the review of KNAURS VOGELBUCH published on page 151 of Vol. 55, the price was omitted. The publishers inform us that it is DM. 12.80=Rs. 14.85.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1957

President

SHRI SRI PRAKASA, *Governor of Bombay*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S.
Rev. Fr. H. Santapau, S.J.
Mr. Sálim Ali

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Mr. J. A. Singh, I.F.S.
Dr. D. V. Bal, M.SC., Ph.D.
Mr. G. V. Bedekar, I.C.S.
Mr. R. E. Hawkins
Dr. C. V. Kulkarni, M.SC., Ph.D.
Mr. D. N. Marshall
Mr. D. J. Panday
Mr. D. E. Reuben, I.C.S. (Retd.)
Mr. Humayun Abdulali (*Hon. Secretary*)
Mr. M. J. Dickins (*Hon. Treasurer*)

Advisory Committee

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Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. ...	*New Delhi*
Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D.	*Mysore*
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Col. R. C. Morris, F.R.G.S., F.Z.S.	*Attikan*
Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)	*Nilgiris*
Dr. M. L. Roonwal, M.SC., Ph.D., F.N.I., F.Z.S.I. ...	*Calcutta*
Dr. Baini Prasad, D.SC., F.N.I.	*Dehra Dun*

List of members of the Executive and Advisory Committees elected for the year 1958:

President

SHRI SRI PRAKASA, *Governor of Bombay*

Vice-Presidents

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Rev. Fr. H. Santapau, S.J.
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Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D.	*Mysore*
Mr. E. P. Gee, M.A., C.M.Z.S.	*Assam*
Col. R. C. Morris, F.R.G.S., F.Z.S.	*Attikan*
Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)	*Nilgiris*
Dr. Baini Prasad, D.SC., F.N.I.	*Dehra Dun*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	*Roorkee*
Dr. M. L. Roonwal, M.SC., Ph.D., F.N.I., F.Z.S.I. ...	*Calcutta*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1957

THE SOCIETY'S JOURNAL

Parts 2, 3, and 4 of Volume 54 were published.

MAMMALS

W. C. Osman Hill and A. H. Booth in 'Voice and Larynx in African and Asiatic Colobidae' give a preliminary account of the laryngeal specialisation in the Primate family Colobidae. The principal anatomical features of the larynx of seven genera including the Indian langurs have been studied and an attempt made to correlate the laryngeal mechanisms, ranging from the relatively simple arrangements in *Procolobus* to the large and complex larynx of *Colobus* (*sensu stricto*), with their vocal performances, The paper also throws light on the close relationship of the African genus *Colobus* (*sensu stricto*) to the Asiatic *Presbytis* and to the distinctiveness of *Procolobus.*

Mrs. Aruna Banerji in continuation of her paper published in the *Journal* **53** (2): 261 has given a detailed account of certain aspects of the family life of the Fivestriped Squirrel *Funambulus pennanti* Wr. The female attains maturity between the age of 6 and 8 months and appears to take the initiative in the pre-mating activities. The gestation period averages between 40 and 42 days and observations on one squirrel over about $3\frac{1}{2}$ years reveal that there are three litters a year, with an average of three young per litter.

In 'The Abominable Snowman' Swami Pranavananda has attempted to dissuade believers and to convince them that the Yeti is a myth and not a reality. The Swami has studied the problem in the course of his extensive travels in the Himalayas. The word 'Yeti' is derived from the Tibetan word *my-te*, meaning 'abominable, filthy, disgusting to a repulsive degree or dirty'. He concludes that *te* (brown bear) and *my-te* (man bear or red bear) which may be identical are responsible for the footprints that have caused all this controversy.

Mrs. Swarna Subramoniam has recorded the habits of 8 specimens of the Slender Loris *Loris tardigradus* (Linnaeus) kept in captivity under conditions simulating their natural environment. The Slender Loris is omnivorous in its diet and it is noted that they use their molars and not their incisors for seizing the insects and other food offered to them. The extreme adaptability of the limbs of this animal is well illustrated by a series of 30 line drawings. The author has also discussed their sociability and docility, the sounds they produce, and their intelligence which is of a very low order.

'The Lion of the Gir' is a chapter from the late Lt.-Col. A. H. E. Mosse's unpublished manuscript entitled 'Indian hours with Nature. being ramblings of a naturalist shikari'. These notes were written in 1936 and provide an interesting background to the recent efforts at counting the total population of lions and their preservation.

BIRDS

Sálim Ali and V. C. Ambedkar record more observations on the biology of the Weaver Bird *Ploceus philippinus* Linn. made at two control colonies, one in Poona and the other in Bombay. Confirmatory evidence of many of their earlier findings [*JBNHS* **53**: 381-389 (1956)] is available and further notes on clutch size, percentages of successful hatching and nestling in the control colonies, natural mortality and sex ratios among nestlings, nest building and intelligence denote possibilities of much more work of great interest on these birds.

'Notes on the Birds of a selected area of Dehra Dun—June 1946 to July 1951' by the late Mrs. M. D. Wright embodies observations made during five years covering 227 species and subspecies. Notes on movements, relative abundance, breeding, courtship, nesting, etc. are given under each species.

In 'Notes on Specific Identification in the Tawny Pipit (*Anthus campestris*), Blyth's Pipit (*A. godlewskii*), and Richard's Pipit (*A. novaeseelandiae*) in Asia', Mrs. B. P. Hall discusses the geographical variation in these three species, some forms of which are resident in or visit India every year, and also the problem of their identification in the museum. The streaks and spots on the body and the tail, the size and shape of the hind claw, and the relative lengths of the wing and tarsus are important characters which assist in the study of a difficult subject.

The ecological study 'The Blackfaced Weaver Bird or Dioch in West Africa' by G. Morel, Marie-Yvonne Morel, and François Bourliere covers *Quelea quelea*, a bird which has been a major pest of wheat and other cereal crops in parts of Africa. In the losses which it causes, the Dioch is often compared by modern agriculturists to locusts. The study is based on observations made in its natural surroundings and on breeding experiments since 1953.

'Terns of the Seychelles Islands' by M. W. Ridley covers observations made during four months in the breeding season in 1955. The Common and the Lesser Noddy, the Sooty, the Brownwinged, the Crested, the Roseate, the Blacknaped, and the White Terns were found nesting while the Little and the Caspian Terns were non-breeding visitors.

REPTILES

'Reptiliana' is another chapter from the late Lt.-Col. A. H. E. Mosse's unpublished manuscript referred to earlier. No other paper on this subject was available.

FISH AND FISHERIES

S. V. Gokhale in 'Operations of the *Dol* Net off Saurashtra Coast' describes the net so widely used for the 'Bombay-duck' but on which so very little literature is available.

D. V. Bal and K. H. Mohamed's 'A Systematic Account of the Eels of Bombay' refers to fourteen species, four of which are new to this area.

In 'Bionomics of Forage Fishes' K. H. Ibrahim has observations on the fecundity of three common species of minor barbels, *Puntius stigma, P. ticto,* and *P. vittatus.* The author finds the fecundity of these species high enough to suggest their introduction into tanks as food for the culture of Murrel (*Ophicephalus* spp.), which is extremely predaceous and which has not been successfully reared in India.

INVERTEBRATES

Entomology:

D. G. Sevastopulo in the fourth and concluding part of his 'Notes on the Heterocera of Calcutta' reports on the Pyralidae, which though small are often of outstanding beauty and of which many species exhibit marked sexual dimorphism. In all 138 species in 9 subfamilies, some of which are of economic importance, are mentioned with notes on their abundance, time of occurrence, etc.

In 'Notes on the *Brüelia* Group of Mallophaga (feather-lice), with Descriptions of four new species', W. Eichler draws attention to the correlation of the different Mallophaga to the phylogeny and systematics of their avian hosts, and suggests methods of collecting feather-lice.

'Brief Notes on Crop Pests and their Control in the Panjab (India)' by K. N. Trehan deals with the common pests which are found not only in the Panjab but in other parts of the country also.

The sugarcane leaf-hopper *Pyrilla perpusilla* Walk. is a serious pest and B. R. Subba Rao gives a detailed account of the biology and bionomics of the Hymenopterous Dryinid *Lestodryinus pyrillae* Kieff, which as a nymphal parasite on *Pyrilla* keeps down its population in sugarcane fields and forms an excellent instance of biological control useful to agriculture.

S. Krishnaswami, N. S. Chauhan, and P. S. Negi in 'Studies on non-insect Enemies of Lac, with special reference to Squirrels and Birds as serious seasonal Predators' have drawn attention to the damage caused by squirrels and birds in summer when the lac crop matures. Their conclusions are based on the analysis of the stomach contents of 36 Fivestriped Palm Squirrels (*Funambulus pennanti*) obtained in the Kundri forest in Palamau District of Bihar, which indicated that they fed voraciously on the maturing lac insects in June. As against this it was found that during the October season they visit the lac crop mainly for the lac predators. The stomachs of 58 birds of 16 species revealed that woodpeckers and bulbuls also damage the maturing lac crop to a small extent.

Arachnida:

The mating habits of the South Indian Scorpion *Heterometrus scaber* Thorell are described by A. P. Mathew. The author has explained certain anomalies noticed in the male reproductive system of scorpions and has re-named the so-called 'sheath of the copulatory organs' and 'penis', terms used by earlier authors, as the '*spermatophoral sac*' and '*valves of the spermatophore*' respectively. It is now accepted that the male after courtship deposits a packet of sperms (spermatophore) before the female who sucks it up into her genital opening.

Crustacea:

B. F. Chhapgar in Parts I and II of 'The Marine Crabs (Decapoda: Brachyura) of Bombay State' gives a detailed systematic account of 81 species and subspecies of crabs found along the Bombay coast. Almost all the species are illustrated with 13 in colour. A key to the identification of the species and subspecies is followed by a discussion on the geographical distribution of these crabs in the Indo-Pacific Region and observations on the ecological adaptation of the major species. This paper is now being brought out as a book by the Director of Fisheries, Bombay State.

In 'Influence of stage of Tide on the attachment of Barnacle Cyprids' A. Daniel has shown that various species of barnacles respond differently to the different stages of the tide, and suggests that these differences are associated with the nature of their habits rather than any inherent response to tidal rhythm. Cyprids of *Balanus amphitrite* settle in large numbers during low tide and *Chthamalus stellatus* at high tide, while *Balanus tintinnabulus* is indifferent to the stage of the tide.

MOLLUSCA

N. Balakrishnan Nair records 18 species of shipworms of the genera *Bankia* Gray and *Teredo* Linnaeus from the coast of south India and gives a detailed report on the anatomy of one of the species *Bankia indica* Nair. A study of the breeding season and development of this species shows that most larval development and settling occurs in August. The breeding is continuous throughout the year with two peaks, one in December and the other in May-June. From the data obtained from test-planks of red cedar used for a period of 219 days the author concludes that, after the attachment of the larva, the growth is very rapid for the first 90 days from whence it slackens and almost ceases after eight months.

In another paper, N. Balakrishnan Nair and O. N. Gurumani record the distribution and salient features of eight species of shipworms found in two important fishing centres, Tondi and Adirampatanam on the east coast of India. The authors note that the turbidity of the water was not a deterrent to the borers and their preference for any particular timber depended largely on its availability in the area.

GENERAL ZOOLOGY

In an article entitled 'History of our Knowledge of the Indian Fauna through the Ages', H. S. Rao has brought together scattered and little known facts that furnish a better pattern of the background of our knowledge through the ages which has not been available to the students of biology and its history. Chronological groups from the 3rd and 4th Millenia B.C. in the Indus Valley and the adjoining territories of Sind, Punjab, and Baluchistan cover the Vedic period (2000 to 600 B.C.) the Upanishads, Susruta Samhita, etc., the period of the Sangam Literature in the Tamil country, the Sultanate and the Mogul followed by the post-Mogul, continuing up to modern times.

'On a Zoological Collecting Tour of the Islands Off Jaffna' by P. H. D. H. De Silva is a preliminary report on the land and freshwater vertebrate fauna of 8 islands in the Gulf of Mannar visited by the author for three weeks from the middle of February 1956. 23 species of brackish and freshwater fishes, 8 of amphibia, 18 of reptiles, 63 of birds, and 4 of mammals are recorded. From the material obtained it is deduced that zoo-geographically the island fauna shows considerable affinities to those of peninsular India.

'On the Marine Fauna of the Gulf of Kutch' by P. W. Gideon, P. K. B. Menon, S. R. V. Rao, and K. V. Jose is a preliminary faunal survey of Port Okha, Pirotan Island, and adjacent areas of the Kathiawar Peninsula. Among the zoological specimens collected is the Echiuroid *Ikedella misakiensis* (Ikeda) which constitutes the first record from Indian waters. The entire collection is deposited in the Museum of the Department of Zoology, Birla College, Pilani.

BOTANY

A study of the flora of Harsh Nath, one of the highest peaks in the Aravalli range, has enabled N. C. Nair and G. S. Nathawat to record 223 species belonging to three different elements: (1) Western (African-Persian), (2) Eastern (Malayan), and (3) Indian. Of these, the Western element is predominant. The authors have attempted to group the principal plant associations and an altitudinal zonation is indicated.

In 'A Botanical Trip to the Valley of Flowers' B. N. Ghildyal lists 283 species and six varieties belonging to 74 families from the Bhyundar Valley (Valley of Flowers) situated about 13,000 feet above sea-level in the Garhwal District of Uttar Pradesh.

K. M. Gupta and T. N. Bharadwaja, in Part I of their paper on Indian Marsileas, report the results of their study of 82 herbarium sheets of the genus *Marsilea* from four different collections. The report covers the characteristics of the sporocarp, the variability in size, shape, and structure, particularly in the widely distributed *Marsilea minuta.*

In the 'Grass Flora of Coimbatore District (South India) with special reference to Fodder Grasses', J. Sakharam Rao lists 178 species together with notes on their distribution and economic importance.

H. Santapau and V. Patel give a systematic account of the genus *Cuscuta* Linnaeus occurring in Bombay State. Descriptions of four species and a variety are followed by keys for the identification of the species and of the subdivisions of the genus *Cuscuta.*

'Observations on the Flora of Kodaikanal' by J. Pallithanam embodies results of a preliminary survey, including a few new distributional records and some notes on their morphology, etc.

'A Contribution to our Knowledge of the Diatom genus *Pinnularia*' by H. P. Gandhi is a systematic account of 17 species and varieties, of which two species and varieties are described as new to science and nine listed as new records for India.

'The Genus *Eremopogon* Stapf and its affinities with *Schizachyrium* Nees' contains a critical discussion of both the genera from which the authors M. B. Raizada and S. K. Jain opine that, contrary to earlier belief, a more detailed study of the two genera may show that they are congeneric.

In Part II of 'Botanical Explorations in the Bhillangna Valley of the erstwhile Tehri Garwal State', R. K. Gupta records 98 species belonging to 31 families.

'The Algal Flora of the ponds and puddles inside the Banaras Hindu University Grounds, India' by V. S. Venkataraman is another taxonomic paper, listing 61 species and varieties with notes thereon. The author describes 5 varieties and seven forms as new to science.

D. D. Sundararaj and V. Ramakrishnan record two new species, *Lippia unica* and *Cenchrus glaucus,* in Part II of the series entitled 'New Plant Records for South India'.

Miscellaneous Notes

72 notes covering 11 branches of natural history were published as against 116 last year. This section of the *Journal* is very popular

with readers, and the great decrease in the number of notes that we have received is a matter of grave concern not only to the editors but also to the Society as a whole. These contributions from members and others are always an index of the general interest in natural history and also serve to arouse interest and memories in others.

NATURE EDUCATION

The Nature Education Scheme financed by the Government of Bombay was continued during the year and the third booklet entitled 'Our Beautiful Trees' in the Glimpses of Nature Series was published in English, Marathi, and Gujarati.

The usual activities, including talks on Nature Rambles on the All-India Radio as well as tours and talks at the Museum, the Taraporevala Aquarium, and the Victoria Gardens, were continued.

GENERAL

In addition to the two nature films 'Long Flight' and 'Wild Life and the Human Touch' shown at the Annual General Meeting on 21 August 1957, the Society was fortunate enough to be able to arrange for a lecture-film at the Institute of Sciences, Bombay, on 28 October 1957 on 'The Bird Islands of Peru' by Dr. Robert Cushman Murphy, former Head of the Bird Division, American Museum of Natural History, and author of the well-known book 'OCEANIC BIRDS OF SOUTH AMERICA'.

REVENUE ACCOUNTS

The total receipts during the year amounted to Rs. 50,992, including grants of Rs. 10,000 and Rs. 4,000 received from the Governments of India and Bombay respectively, as compared with Rs. 49,373 during the previous year.

The fall in the income from subscriptions during 1957 is in a large measure due to the delay on the part of members in settling their outstanding subscriptions; these are being followed up actively. The reduction in the entrance fee from Rs. 25 to Rs. 5 has resulted in a decrease under this heading as unfortunately there has been no appreciable improvement in the number of new members.

The decrease in sales of our publications this year is partly on account of 'THE BOOK OF INDIAN ANIMALS' being out of print. Sales of back numbers of the *Journal*, however, were a little higher than in the previous year.

The following is a comparative statement showing the sources of revenue in 1956 and 1957:

	Revenue in 1956	Revenue in 1957	Increase in 1957	Decrease in 1957
	Rs.	Rs.	Rs.	Rs.
Subscriptions ..	21,303	17,876	——	3,457
Entrance Fees ..	1,589	1,318	——	271
Publications:				
Books ..	9,677	9,091	——	586
Journals ..	4,421	4,897	476	——
Sundries ..	341	111	——	230
Interest on Investments and others ..	4,042	3,699	——	343
Grants:				
Govt. of India ..	4,000	10,000	6,000	——
Govt. of Bombay ..	4,000	4,000	——	——
Total ..	49,373	50,992	6,476	4,857

The total number of members on our books as at 31 December 1957 was 1234, of whom 231 were life members and 6 honorary members. Subscriptions for 1957 were received from 596 ordinary members, leaving 401 still to be paid; arrangements are in hand to carry out a through check of the membership and to bring our register up-to-date, as it is known that in some cases subscriptions have remained unpaid for a number of years despite the reminders which have been sent out regularly.

During the year, 65 new ordinary members and 3 life members joined; 2 ordinary members became life members and 14 ordinary members resigned, whilst 6 ordinary members and 1 honorary member died. There was thus a net increase of 47 members on the register.

STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

ACKNOWLEDGEMENTS

The Committee's thanks are due to the late Mr. P. M. D. Sanderson who looked after the Society's interests in the United Kingdom until his death on 8 September 1957. Mr. J. L. Bernard, who was formerly on the Executive Committee of the Society in Bombay, has agreed to look after the Society's interests in the United Kingdom.

APPENDIX TO THE HONORARY SECRETARY'S REPORT COVERING THE PERIOD JANUARY TO AUGUST 1958

Copies of the report for the year ending 31 December 1957 are available to you, but I would make a few remarks regarding some matters of interest during the current year.

I will first refer to the award of the Padma Bhushan by the President of India to Mr. Sálim Ali for the work which he has done for ornithology in India. In view of his close association with the Society over many years, I think that this is an honour not only to him but also to the Society. He is now at Helsinki in Finland attending an International Ornithological Conference. He has also been elected Fellow of the National Institute of Sciences of India.

The Society has been recognised by the University of Bombay as a teaching institute for research for the M.Sc. degree in Zoology (Field Ornithology) and Dr. J. H. Crook of Cambridge University, who is to be one of our teachers, has already commenced his personal work on the study of the breeding habits of the baya at Poona where a large base aviary has been set up. After finalisation of a few technical matters, it will be possible for the Society to enrol three students for the study of a subject which, in spite of its undoubted value and importance, has yet remained completely unrecognised by Indian universities.

Last year I referred to negotiations with the Prince of Wales Museum and the Government of India regarding the construction of a separate building for the Society's offices, library, and reference collections in the Museum grounds in Bombay. The negotiations have progressed satisfactorily, and we hope that it will be possible to have this building go up in the next few years. In the meantime, the Government of Bombay and the Rockefeller Foundation have agreed to make us grants to the extent of Rs. 45,000 each, and this would enable us to move into rented premises large enough to house us together with the reference collections which are now at the Museum. This is receiving our immediate attention and we hope to be able to take some definite action during the course of this year.

The Sir Dorabji Tata Trust has for the second time placed Rs. 3,000 at our disposal for the encouragement of biological research in the field. Some of the papers relating to the work done with the assistance of the first grant have been published in the *Journal* and we hope that it will be possible to get more and more people interested in widely differing but still fascinating subjects.

The manuscript of the second edition of the Animal Book has at last gone to the press and it should be ready by the end of the year.

The Wall Chart on the identification of poisonous snakes, in English, Marathi, and Gujarati, is in the final stages of printing and a check-list of Indian Birds by Dillon Ripley is also in the course of preparation.

The following 62 members have joined since the last Annual General Meeting:

FROM 16 AUGUST TO 31 DECEMBER 1957

Mr. Oliver C. Schmidt, Northfield, Illinois, U.S.A.; The Staal Museum Für Natürkunde, West Germany; Mr. David Reuben, Ahmedabad; Indian Central Oil Seeds Committee, Hyderabad, Dn.; Rev. Fr. E. B. O'Connor, S.J., Bihar; Mr. Peter F. R. Jackson, New Delhi; Dr. K. P. Karanth, Hyderabad, Dn.; H. H. The Maharao Sahib Bahadur of Kotah, Kotah (Rajasthan); Mr. Oscar M. Root, North Andover, Mass., U.S.A.; Rev. Br. Antony Navarro, S.J., Bombay; Mr. M. Lee Bristol, Collinsville, Conn., U.S.A.; Dr. Raymond Andrew Paynter Jr., Cambridge, Mass., U.S.A.; The Principal, Arts & Science College, Warangal; Mrs. Maureen Miller, East Pakistan; Mr. Harischandra Vinayak Desai, Bombay; Mr. William Hagstrom, Assam; Dr. T. H. Bassett, Alberta, Canada; Dr. E. G. Silas, Bombay; Mr. Dana Larson, Assam; Rev. Fr. L. M. Balam, Tiruchirapalli; Mr. Ashoke Bir, Bombay; Rev. Fr. A. Carnilleri, S.J., Kurseong; Mr. K. Dorayya Reddy, Anaparti; Capt. S. K. Daug, Deolali; Mr. J. T. Holland, Bombay; Mr. John Goatly, Bombay; Miss Mehera D. S. Dubash, Bombay; Mr. H. A. Kern, Nilgiris; Mr. A. V. Venkateshwaran, Bombay; Mr. R. Murlidhar, Bombay; Mr. S. Goswami, Calcutta; Prof. F. Bourliere, Paris, France; Capt. H. A. Mohite, Ahmedabad.

FROM 1 JANUARY TO 18 JUNE 1958

Mr. F. O. C. Andrade, Coorg; Mr. V. C. Martin, New Delhi; Mr. John K. Almond, Quilon; Capt. Jean Deuve, Vientiane, Laos; Deputy Director, Animal Husbandry Department, Patna; Mr. Allan F. Mortimer, Dehra Dun; Mr. G. E. Thomson, Bombay; Mr. C. J. E. Gurr, Bombay; The Headmaster, Khrist Raja High School, Bettiah; Mr. Lim A. Bilimoria, Bombay; Dr. B. Mehta, Bombay; Mr. Peter Aufschnaiter, Nepal; Mr. F. Wild, Burnpur; Mr. John Alfred Cook, Assam; Rajyaratna Prataprai G. Mehta, Jaipur; Maharaj Shri Madhusudan Singhji, Banaskanta; Dr. R. Mertens, Frankfurt, Germany; Mr. J. Joseph Raj, Madurai; Mr. K. S. Desai, Kenya, Br. E. Africa; Mr. Kraig K. Adler, Columbus, Ohio, U.S.A.; Mr. G. W. Peck, Assam; Mr. Adi C. P. Wadia, Bombay; Mr. D. A. T. James, Assam; Mr. H. J. Dadachanji, Ahamedabad; Dr. E. Lloyd Cunningham, Bulsar; Divisional Forest Officer, Assam; The President, Regimental Institute 9th Bn. Assam Rifles, Assam; Mr. Pesi Phiroze Birdi, Bombay; The Registar, Utkal University, Cuttack.

THE BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31 DECEMBER 1957

FUNDS AND LIABILITIES		Rs nP	Rs nP
Trust Fund or Corpus:			
Life Membership Fund			
Balance as per last Balance Sheet ...		95,390.28	
Add : Amount received during the year ...		1,800.000	97,190.28
Other Earmarked Funds :			
Expedition Fund		1,800.0	
Field Work Fund			
Balance as per last Balance Sheet	614.67		
Less : Expenses during the year	84.95	529.72	
Wild Life Fund		715.25	
Mammal Survey Fund			
Balance as per last Balance Sheet	3,627.52		
Less : Expenses during the year	361.79	3,265.73	
Building Fund		30,000.00	
Reserve for Snake Wall Charts ...		3,000.00	39,310.70
Liabilities :			
For Expenses		20,821.07	
,, Advances (Subscriptions and Entrance Fees)		1,210.10	
,, Sundry Credit Balances ...		6,014.10	28,045.27
Income and Expenditure Account			
Balance as per last Balance Sheet		47,640.03	
Less : Deficit as per Income and Expenditure Account		9,541.54	38,098.49
Carried forward ...			2,02,644.74

ASSETS			Rs nP	Rs nP
Immovable Properties :				nil
Investments (at cost) :				
Rs. 14,000 4% Bombay Port Trust Bonds			10,780.00	
,, 15,000 4% Bombay Improvement Trust Bonds ...			11,400.00	
,, 36,000 3% Funding Loan 1966-68			35,812.62	
,, 25,000 3% Conversion Loan 1946			25,000.00	
,, 2,000 3% First Development Loan 1970-75 ...			1,948.75	
,, 92,000			84,941.37	
(Market value on 31st December 1957 Rs. 80,318.00)				
£460 3½% Defence Bonds			6,133.34	
Less : Provision for Depreciation ...			3,750.00	87,324.71
Furniture and Fixtures :				
Balance as per last Balance Sheet ...			1,914.06	
Additions during the year			355.30	
			2,269.36	
Less : Depreciation during the year ...				2,030.11
Loans : (Secured)	***Good***	***Doubtful***		
Loan Scholarship ...	nil	nil		
Other Loans (to staff) ...	65.00	,,		65.00
Advances :				
To Trustees			nil	
,, Employees			,,	
,, Contractors			570.70	
,, Lawyers			nil	
,, Others			1,010.67	1,581.37
Income Outstanding* :				
Rent			nil	
Interest			,,	
Other Income:				
Supplies and Services			9,758.6	
Government of India (Grant)			10,000.00	
Government of Bombay (Grant) ...			4,000.00	23,758.64
Carried forward ..				1,14,759.83

* The accounts for interest received are maintained on a cash basis. The interest outstanding as at 31-12-1956 amounts to Rs. 1,426-10-6.

BALANCE SHEET AS AT 31 DECEMBER 1957—(*continued*)

FUNDS AND LIABILITIES		Rs nP	ASSETS	Rs nP	Rs nP
Brought forward ...		2,02,644.74	Brought forward ...		1,14,759.83
			Stock of Books on hand:		
			At cost or under, as certified by the Honorary Secretary		68,610.60
			Cash and Bank Balances:		
			(*a*) *In Current Account with:*		
			National Bank of India, Ltd., Bombay	12,460.70	
			National Bank of India, Ltd., London	6,463.61	
			(*b*) With the Trustees	Nil	
			(*c*) With the Cashier	350.00	19,274.31
Total ...		2,02,644.74	Total ...		2,02,644.74

**Income Outstanding*	
Rent	Nil
Interest accrued	1,189.00
Other Income	Nil
	1,189.00

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Properties and Assets of the Trust.

BOMBAY, *28th April 1958.*

For Bombay Natural History Society
(Sd.) SALIM ALI,
Trustee.

As per our report of even date.
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

THE BOMBAY NATURAL HISTORY SOCIETY

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31 DECEMBER 1957* Cr.

EXPENDITURE	Rs nP	Rs nP
To *Expenses in respect of Properties:*		
Rates, Taxes, Cesses, Repairs, and Maintenance	nil	
Salaries	,,	
Insurance	,,	
Depreciation (by way of provision or adjustments)	,,	
Other expenses	,,	nil
Establishment Expenses:		
Salaries (including Dearness Allowance)	28,179.45	
Society's contribution to Staff Provident Fund	1,029.52	
Rent	2,400.00	
Postage	1,045.25	
Printing and Stationery...	1,316.98	
Editor's Travelling Expenses	1,200.00	35,171.20
Remuneration to Trustees:		nil
Legal Expenses:		nil
Audit Fees:		500.00
Contribution and Fees:		nil
Amounts written off:		
Bad Debts	nil	
Loan Scholarships	,,	
Irrecoverable Rents	,,	
Other items	,,	nil
Miscellaneous Expenses:		
General Charges (including Rs. 318.00 for Secretary's travelling expenses) ...	1,871.83	
Fire Insurance	664.84	
Sales Tax and Central Sales Tax ...	409.01	2,945.68
Carried forward ...		38,616.88

INCOME	Rs nP	Rs nP
By *Rent:* Accrued	nil	
Realised	,,	nil
Interest (Realised):		
On Securities	3,252.67	
,, Bank Account	446.68	3,699.35
Dividends		nil
Donations in cash or kind		,,
Grants:		
Government of India	10,000.00	
Government of Bombay	4,000.00	14,000.00
Income from other sources:		
Subscriptions	17,876.60	
Entrance Fees	1,318.89	19,195.49
Publications:		
Journal Sales	4,897.49	
Books etc., Profits:		
Book of Indian Birds	2,804.14	
Book of Indian Animals	65.87	
Some Beautiful Indian Climbers and Shrubs	1,572.37	
Some Beautiful Indian Trees... ...	1,096.35	
Butterflies of the Indian Region ...	964.54	
Circumventing the Mahseer and other Sporting Fish	545.98	
Game Birds Vol. III...	86.15	
Indian Molluscs	85.13	
Calendars	1,700.52	
Other Publications	168.1	
Taxidermy, etc.	110.97	14,097.52
Carried forward ...		50,992.36

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31 DECEMBER 1957—(*continued*) Cr.

EXPENDITURE	Rs nP	Rs nP	INCOME	Rs nP	Rs nP
Brought forward ...		38,616.88	Brought forward ...		50,992.36
To Depreciation :			*By Deficit carried to Balance Sheet* ...		9,541.54
On Investments	1,000.00				
,, Furniture	239.25	1,239.25			
Amount transferred to Reserve or Specific Funds :		nil			
Expenditure on Objects of the Trust :					
(*a*) Religious	nil				
(*b*) Educational—Journal Expenses ...	19,354.21				
Library	1,323.56				
(*c*) Medical relief	nil				
(*d*) Relief of poverty	,,				
(*e*) Other charitable objects	,,	20,677.77			
Total ...		60,533.90	Total ...		60,533.90

BOMBAY, *28th April, 1958*

As per our report of even date
(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

For Bombay Natural History Society
(Sd.) SÁLIM ALI,
Trustee.

THE BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31 December 1957

RECEIPTS	Rs nP	PAYMENTS	Rs nP
To Balance as at 1 January 1957 brought forward	2,920.46	By Cost of Nature Study Pamphlets	469.75
Grant from Government of Bombay for 1956-57	6,100.00	Salary of Nature Education Organiser	4,960.00
Interest Account	6.55	General Charges	120.77
Sales of Booklet No. I	278.50	Printing and Stationery	91.39
Sales of Booklet No. II	194.50	Postage	119.56
Sales of Booklet No. III	165.50	Cost of Publishing Booklet No. II	2,407.08
Sales of Nature Study Pamphlets and line drawings	71.80	Cost of Blocks for Booklet No. III	241.28
Bombay Natural History Society (Advance)	1,000.00	Cost of Blocks for Booklet No. IV	1,105.85
		Bank Balance carried forward	1,221.83
Total ...	10,737.31	Total ...	10,737.31

BOMBAY *28th April 1958.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE DURBAR HALL, ASIATIC SOCIETY OF BOMBAY, TOWN HALL, BOMBAY ON WEDNESDAY 18 JUNE 1958 AT 5.45 P.M. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR

1. The Honorary Secretary proposed that the Report for the year ended 31 December 1957 which had been circulated to members prior to the meeting be taken as read. Messrs P. F. Merwanji and T. Gay were both of the opinion that members had not had sufficient time in which to peruse the Report and that it should be either read or circulated sometime before the meeting. The Honorary Secretary explained that the Annual Report was mainly a precis of the articles published in the *Journal* and was subsequently reproduced in full in the *Journal,* and apart from this the cost of such circulation was considerable. After some discussion the Chairman assured the meeting that the Committee would consider the matter and try and make arrangements whereby members would have earlier access to the Report[1]. The Report was then taken as read and adopted.

2. The Balance Sheet and Statement of Accounts presented by the Honorary Treasurer were approved and adopted after a similar objection and assurance.

3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted by the meeting.

4. The Honorary Secretary then read a Supplementary Report on the activities of the Society since 1 January 1958 (see page 399).

5. After completion of the formal business, the Honorary Secretary introduced Dr. Telford H. Work of the Virus Research Centre, Poona as the speaker of the evening. Dr. Work then exhibited his film 'Arctic to the Tropics' and delivered a running commentary on the large variety of birds, animals, plants, and other items shown in the film. Both the talk and the film were greatly appreciated by the meeting which terminated with a vote of thanks to Dr. Work and to the Asiatic Society for the loan of the hall.

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[1] The Executive Committee has since decided that the notice which goes out to members two weeks before the Annual General Meeting shall state that both the Report and the Balance Sheet were available for perusal at the Society's office to all members wishing to see them. A certain number of extra copies shall be available for members who specifically wish to receive them.

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS
18 CHURCH ROAD, VEPERY, MADRAS—25-9-58. C301
EDITORS: SÁLIM ALI, AND H. SANTAPAU
114 APOLLO STREET, FORT, BOMBAY

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. With many coloured and black and white plates. 2nd (revised) edition. (*In preparation*)

Birds

Game Birds of India, by E. C. Stuart Baker. Vol. III. Pheasants, 1st Edition. **Rs. 20**
(*Price to Members Rs.* 15)

The Book of Indian Birds, by Sálim Ali. With 56 coloured and 22 black and white plates, 5th (new) edition, revised and enlarged. **Rs. 20**
(*Price to Members Rs.* 16)

Fish

Circumventing the Mahseer and Other Sporting Fish in India and Burma, by A. St. J. Macdonald. With coloured and black and white plates. **Rs. 15**
(*Price to Members Rs.* 12)

Miscellaneous

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 2nd edition. Revised by W. T. Stearn. **Rs. 20**
(*Price to Members Rs.* 16)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. **Rs. 22**
(*Price to Members Rs.* 17.50)

Butterflies of the Indian Region, by M. A. Wynter-Blyth. With 27 coloured and 45 monochrome plates. **Rs. 28**
(*Price to Members Rs.* 22.50)

Indian Molluscs, by James Hornell. With 2 coloured and many monochrome plates, and text figures. **Rs. 6**
(*Price to Members Rs.* 4.50)

Glimpses of Nature Series Booklets :
- OUR BIRDS, 1 (with 8 coloured plates) in English, Gujarati, Hindi, Kannada and Marathi. **62 nP**
- OUR BIRDS, 2 (with 8 coloured plates) in English, Gujarati, Hindi and Marathi. **62 nP**
- OUR BEAUTIFUL TREES, 3 (with 8 coloured plates) English. **62 nP**

(Editions in provincial languages in preparation)

Wall Chart to distinguish a Wild Dog from a Domestic Dog or Jackal, etc. **Rs. 2.50**

Identification of Poisonous Snakes—Wall charts in English, Gujarati and Marathi. (*In preparation*)

Back numbers of the Society's Journal. Rates on application.

Obtainable from :

The Honorary Secretary,
Bombay Natural History Society,
91 Walkeshwar Road, Bombay 6.

Agents in England :

Messrs. Wheldon & Wesley Ltd.,
Lytton Lodge, Codicote, Nr. Hitchin,
Herts, England.

The Society will gratefully accept back numbers of the Journal, particularly numbers prior to Vol. 45, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Life Members pay an entrance fee of Rs. 5 and a life membership fee of Rs. 500.

Ordinary Members pay an entrance fee of Rs. 5 and an annual subscription of Rs. 30.

The subscription of members elected in October, November and December covers the period from the date of their election up till the end of the following year.

MEMBERS RESIDING OUTSIDE INDIA

The terms are the same for members living outside India. Such members should pay their subscriptions by means of orders on their Bankers to pay the amount of the subscription, plus postage—in all Rs. 32.50—to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £2-9-8 should be paid annually to the Society's London bankers—The National Overseas & Grindlay's Bank Ltd., Bishopsgate Street, London, E.C.

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Journal of the Bombay Natural History Society

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Vol. 55, No. 3

Editors
SÁLIM ALI & H. SANTAPAU, S.J.

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NOTICE TO CONTRIBUTORS

Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names to be printed in italics should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼×2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text-figures, line drawings, and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949): The Genus *Nyctemera* Hübner. *Trans. ent. Soc. Lond.* **100** (2): 47-70.

Prater, S. H. (1948): The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis:* Each scientific paper should be accompanied by a concise, clearly written synopsis, normally not exceeding 200 words.

10. *Reprints:* Authors are supplied 25 reprints of their articles free of charge. In the case of joint authorship, 50 copies will be given gratis to be distributed among the two or more authors. Orders for additional reprints should be in multiples of 25 and should be received within two weeks after the author is informed of the acceptance of the manuscript. They will be charged for at cost plus postage and packing.

91, Walkeshwar Road,
Bombay 6.

EDITORS,
Journal of the Bombay Natural History Society.

This part completes the present volume. In future each volume will consist of the three parts issued during the calendar year.

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Small Game Shooting and Conservation in Northern India—with some Observations on the Bombay Wild Animals and Wild Birds Protection Act 1951[1]

BY

O. H. DE ST. CROIX

Until quite recently there existed on either side of the Delhi-Alwar road, between Sohna and Firozpur Jhirka, a series of large jheels which provided a winter home for scores of thousands of all sorts of waterfowl. This is the land of the Meos in the Gurgaon District of the Punjab and is overlooked throughout its length by the Kala Pahar, one of the northward-thrusting spurs of the Aravali Range. In a good monsoon this stony ridge drains itself in profusion on to the plain below. To control this capricious flow of water in the interests of cultivation Government constructed a system of long, low bunds over a wide area and after the monsoon the result was a chain of large, shallow jheels, sprouting with vegetation and teeming with aquatic life which formed a paradise for all sorts of water birds. Here one could see at one time or another during a winter season practically the whole range of Indian waders from the several kinds of Stork, and even occasionally a flight of Flamingoes, to diminutive Stints and Sandpipers. Swimming birds of course were also fully

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[1] The comments of Mr. Humayun Abdulali, the Society's representative on the Indian Board for Wild Life and on the State Wild Life Board, who is also an Honorary Game Warden for Bombay State, are given in square brackets in the body of the article.

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represented from Pelicans to Dabchicks with a regular galaxy of intermediate species.

Naturally, what is a water birds' paradise is also a happy hunting ground for the duck-shooting man. These particular jheels together with the huge and historic permanent jheel between Gurgaon and Najafgarh formed the core of the plan to control duck shooting in the District on an organised basis when the late F. L. Brayne was Deputy Commissioner of Gurgaon just over thirty years ago. Unfortunately, it was a plan, which, though temporarily successful, did not outlast its originator. More recently, in the years just before and after the last war these jheels still provided all that the naturalist and shooting-man could hope for. They were then but lightly shot-over and for the casual shooting party, without the advantage of elaborate preparation, afforded both exacting and stimulating sport. Here during the course of a winter season one could count on seeing practically all the species of migratory duck and teal which visit India, including the occasional rarity. In addition, both species of wild goose were regular visitors, the Greylag often in hundreds when the conditions for them were right.

The writer's game book, which covers about 16 years of this period shows 14 species of migratory duck and teal, as well as 5 indigenous species. The number of birds which found their way into the bag was of course only an infinitesimal proportion of those seen, for the shooting parties did not exceed 4 guns as a rule and usually shot for the first four or five hours or so of daylight and that only once a week on an average. In fact it was one of the most satisfying features of this type of shooting that while enjoying excellent sport one appeared to make no real impression on the quarry which seemed to exist in just as great numbers at the end of the season as at the beginning. At times the duck and teal were concentrated in almost incredible numbers and the concerted roar of their wings when they rose to the first shot of the day was a sound that will not easily be forgotten. The greatest concentrations were usually to be seen during the migration assemblies at each end of the season. But between times there was a remarkable change in the appearance of the birds, for by the end of February in the New Year the dowdy eclipse plumage of the previous autumn had given place to immaculate and colourful breeding dress.

Most interesting were the fluctuations in numbers of the various species from time to time over the years. For example in the late 1930's this area seemed to be only on the fringe of the Mallard's range: they were seldom seen and even less seldom bagged. Ten years later the position was very different and Mallard were not only seen regularly in appreciable numbers but quite often formed a sizeable part of the bag. It is difficult to account for this. Similarly, the commonest of the four pochards was formerly the White-eye: more recently their abundance has definitely declined and there has been a noticeable increase in the once rare Tufted Pochard. Most pleasing of all has been the recent increase in the numbers of Spotbill, once rather uncommon in these parts. But where they breed is something of a puzzle in view of the vast increase in human population, cultivation and land reclamation all over this area in the last 10 years or so. One hopes they will continue to keep it a secret.

The proportion of species one to another in the bag by no means reflected their relative abundance at large. One of the commonest duck to be seen on the big jheels, and one of the most conspicuous, was the Pintail, but their wariness makes them difficult to circumvent and they figure sparsely in the records. Similarly Wigeon were nearly always to be seen in fair numbers but are so well able to look after themselves that their appearance in the bag was only occasional. With such an abundance and variety one could always hope for making contact with a real rarity. Twice during this period the occurrence of Bronzecapped Teal was definitely established by birds in the hand. A little more often Marbled Duck were obtained, but their status is difficult to assess accurately owing to their retiring habits. Most prized quarry of all were, as ever, the geese, particularly the Greylag, whose wiliness in the face of pursuit is proverbial, as also should be their excellence as table birds. But a careful study of them reveals that they too are creatures of fixed habits. If careful note were taken of them, a keen and experienced shooting man could reckon on bringing one or two of them to bag in a day with fair regularity during the season. Each such occasion makes an indelible mark on the memory for no one can get too old or sophisticated to experience a thrill on bagging a Greylag Goose by his own efforts.

Today the course of the non-stop air service from Bombay to Delhi lies right over this stretch of country. The eye that knows it intimately from the ground can trace the lay-out with ease from the air and see that all of these Mewat jheels are in a normal year now drained and put under the plough. From the standpoint of the national economy this is a good thing and in step with the march of time. No one, except the ultra-reactionary, can complain if the shooting man's loss is the farmer's gain. But from the aspect of wild life conservation one has to consider what adjustments may be necessary in the face of such developments. For this is not a local trend. With the continual demand for progressive expansion in food production it is likely to be country-wide. This means that with the draining of marsh lands the best feeding grounds for waterfowl will be obliterated and the vast numbers of migratory and indigenous waterfowl, both game birds and otherwise, will have a much restricted choice of winter feeding grounds. They will not often be able to select the safest and most remote as hitherto. They will, assuming that the migratory birds continue to come to this country in the same numbers as before, have to exist in denser concentration than ever if they are to live on their feeding grounds. They will consequently be more vulnerable, especially now that firearms seem to be licensed more freely and widely than hitherto and shooting or netting appears to be practised incessantly, ubiquitously, and with little restraint. Already one hears reports of the growing scarcity of waterfowl in their former haunts. This may be due in part to migrants going elsewhere in which case they are lost to this country all together. Or in part it may be due to a change of habits in that they are only visiting their feeding grounds, where they are most vulnerable, during the hours of darkness. In that case, to the extent that they are game birds, there is a loss to sport and to the supplementary food supply. In either case the situation gives the sportsman naturalist, who cannot but be a conservationist at heart, serious cause for thought. For while it is true that vast areas are being inundated by the new dam projects under the Five Year Plan, the water of these is for the most part too deep to provide a living for large numbers of surface feeding waterfowl.

* * * *

The country within a radius of about 60 miles from Delhi lying within the Gurgaon and Rohtak Districts of the Punjab and the Meerut and Bulandshahr Districts of the U.P. provides an admirably suitable habitat for partridges both Black and Grey. It provides an ideal blend of intensely cultivated, well irrigated farm land with scrub-covered, lightly forested wastes or tracts of thick reeds and pampas grass of the Jamuna Kadir country. This combines the abundant and varied food supply afforded by intensive agriculture and the requisite amount of permanent shelter for safety and nesting purposes provided by the waste land. Country like this can support a very large, though not necessarily evenly distributed, partridge population, which undisturbed by man can maintain itself despite losses from weather conditions and natural enemies. But when there is unrestrained interference from man, the balance is very soon upset even under favourable conditions of habitat such as those described above. The fluctuating effects spread over a long period of years make an interesting and instructive study.

Our predecessors tell us that in the 1920's and before a good partridge shoot was to be had within sight of the Kutub Minar or almost anywhere in the adjoining districts of the U.P. or Punjab within a short tonga drive of Delhi. The march of time has put its foot firmly on that and no wonder, when the growth of New Delhi provided a large market for the professional trapper and the development of motor car travel increased the mobility of the shooting man. Inroads on the partridge population were heavy and not always with respect to seasons or a sporting sense of restraint.

The Black Partridge, being somewhat of a fool so far as self preservation is concerned and also the better eating bird, suffered most and by the early 1930's its status had sunk so low that its killing or capture was totally prohibited in the Gurgaon District. The Grey Partridge, though by nature better able to look after itself, was also heavily reduced in numbers and became scarce even in some of its favourite haunts. Since it has the additional disadvantages of being a popular cage bird and of announcing its presence with irrepressible regularity, it is far from being proof against the wiles of professional netters.

With the outbreak of war things changed for the better fortuitously. Petrol was rationed reducing mobility, the cost of cartridges increased in inverse proportion to their availability, shooting men were preoccupied with grimmer things. It was surprising how quickly the partridge population reacted to these favourable conditions reinforced by wise administrative action on the part of the Punjab Government. In the early 1940's it was possible, within sight of a large town and just off a trunk road not 40 miles from Delhi, to see both species as numerous as they must have been 20 years or so before.

By the time the war ended proper protective legislation had been enforced in the Punjab, which with continued petrol rationing and cartridge scarcity sustained the position for a few years. But as soon as war-time conditions receded into the background and with the population of greater Delhi increasing by leaps and bounds, there was a progressive worsening. Lax administration of the law did not help matters. But more recently the law has been tightened up, particularly as regards netting, and the early 1950's onwards have seen a definite though patchy improvement. Now it is understood that the offering of partridges for sale in Delhi has been made illegal at all times and if this is so a still further improvement is assured, for this checks by far the biggest drain on the stock.

All this should provide some useful lessons for shooting men, for shooting undoubtedly played a part in depleting the partridge stock over the years under review in this area. Partridge shooting in this sort of country is done almost entirely on cultivated land when the birds are in search of food in the growing Rabi crops and are not difficult to flush. In well irrigated tracts, which goes for most of this area, the sugar cane patches are the favourite resort. These are relatively small in extent and can be easily covered by two guns: if well beaten out and with reasonable marksmanship a high proportion of birds seen is brought to bag. A mustard crop is a greater magnet still, especially when running to seed. Here again the patches are small, the concentration of birds sometimes surprisingly large, and the shooting easier.

Seeing that there is no artificial replenishment of stock it seems fairly clear that if the stock level is to be properly maintained some special self-imposed restraint should be practised over and above strict observation of the law, which in this case now imposes a limit per gun daily. There are certain self-imposed rules which can achieve the object in view as the writer can vouch from actual experience. The experience in question is drawn from a week's shooting from camp over a certain tract of well favoured partridge grounds twice, two seasons apart, each time with the same number of guns. On the first occasion observing the law and the self-imposed rules a very satisfactory bag was obtained in four outings. On the second occasion with the same methods and the same number of outings over exactly the same ground there was as good, if not a better, showing of birds and a bag obtained up to the legal limit. On each occasion sufficient birds were left behind to replenish the stock in the normal way.

The self-imposed rules referred to were as follows:

(1) The same ground was not shot over twice in a season,

(2) The number of guns was never more than 3 and they were spaced in such a way that no bird which went straight away could come under fire from more than 1 gun,

(3) The line of draw was pre-determined and any bird which flew out of the area to be drawn (unless known to be wounded) was allowed to go unmolested.

In addition it is felt that, in view of the nesting habits of the three commonest Indian partridges of the plains, the open season should be confined to the four months from November to February inclusive, regardless of what the law may say.

[In the Bombay Act a comprehensive Close Season from 1st April to 31st September is laid down for all small game, partly because of lack of exact information regarding the breeding seasons of the different species but mainly to simplify administration. As very few of the officers concerned would be able to tell the different species apart, it was thought that this differentiation on paper would be useless.

The overall close season is, however, not altogether satisfactory. A little beyond Poona we shot Grey and Painted Partridge on the same day (15th February) when the former had unshelled eggs in the oviduct and the latter showed no signs of breeding. Sandgrouse shot on the same day were also in breeding condition. It is evident that the Close Season for the Grey Partridge and Sandgrouse should commence about the 15th of February if not earlier.]

The foregoing gives an idea of how the interference of man, whether deliberate or not, can affect quickly and drastically the status of birds, mainly game birds, of widely differing habits and environment, both indigenous and migratory. It emphasises the need for intelligent conservation both by law and by the voluntary self-restraint of shooting men. In the Bombay State we are fortunate in that comprehensive legislation has been enacted through the Wild Animals and Wild Birds Protection Act (No. XXIV) of 1951 and its rules. But legislation, however well drafted, by itself is not enough. Its effective implementation is of course essential if it is going to get anywhere near the achievement of its objects. For effective implementation it must have been framed with a due regard for the severely practical aspects of the problem. It is, therefore, highly pertinent to consider how the Act stands in this respect.

In the first place it is as well to be quite clear on the precise object which the Act should set out to achieve. The preamble merely states this as 'to make adequate provision for the protection of wild animals and birds . . .'. Why is it found necessary to provide special protection? To answer this the statement of objects might be expanded as follows to explain the need for protection of fauna as:

(1) to conserve a National Asset but with due regard to the safeguarding of farm crops and livestock, and

(2) to conserve wild life classed as game for shooting by way of sport in a properly conducted manner or for capture as part of the food supply by humane methods.

[The Bill when first published was accompanied by a Statement of Objects and Reasons and most of these matters were referred to in great detail (*JBNHS* 49: 817). The sentiments expressed of course cannot now affect the interpretation or administration of the Act. But since the Act has to be read by everybody taking out a licence under it, it is as well that they should have a clear idea of its basic objects and it may be worthwhile publishing the Objects and Reasons along with the Act.]

To reconcile the interests of the farmer with the need for conservation of a national asset is one of the most difficult aspects of the whole problem. The fact has to be faced that herbivorous wild animals cannot be tolerated where crops are grown and carnivorous wild animals must be kept severely in check where livestock is raised. This is provided for in the Act (Section 50) by enabling the 'occupier' (whatever that may mean) of land to protect his agricultural property freely. But is the administration of this Section being conducted properly or is it courting abuse as it can easily do?

[In old Bombay State (1948) the total number of arms licences was 70,000 of which 50,000 were for sport and 20,000 for crop protection. Before the expansion of the State the total number of licences had increased to 1,20,000 of which those for sport remained at 50,000, the rest being for crop protection!

It is the general consensus of opinion that the only manner in which wild life can be properly protected from the depredations of the farmers is to arrange to recall or seal the guns as soon as the crop is harvested. Sketches showing how all types of guns can be sealed have been circulated, but no action has yet been taken by any State.

It may be worthwhile drawing attention to an unfortunate anomaly whereby Section 38 of the Act, requiring the surrender of animals shot in defence of property, does not cover *female* deer and antelope which are neither 'game' nor 'trophy'.]

There is also provision for classification of certain animals and birds as vermin. Is this really necessary when the interests of cultivators are already safeguarded as above? If it is at all necessary, the list should be a very short one indeed. There are certain inclusions in the existing vermin list which call for immediate comment.

By including all birds of prey and bats there is an invitation to kill some of the best rodent and insect destroyers known to man. Then again it should be remembered that an animal (wild pig for example) may be definitely harmful in a cultivated area and yet not so in a forest area.

[The inclusion of birds of prey and insectivorous bats in the list of 'Vermin' was an unfortunate error, and though nothing has yet been done, the Advisory Board decided on 21st September 1954 that the wild pig should be removed from this category and be included in both Big and Small game.

Actually, in view of Section 50 of the Act there does not appear to be any need of a separate class of animals to be termed 'Vermin' and its inclusion allows for a lot of poaching in many different forms.]

This latter point raises the question of how the Act under reference ties in with the Forest Act and its Rules (which is understood to have its own provision) for regulating shooting and the capture of birds and animals in the Reserved Forest Areas.

[The Forest Act and its Rules still operate, but the Wild Life Act is comprehensive and refers to both forest and non-forest lands. The shooting of 'Vermin' in forest land without a permit from the Forest Department is now prohibited. For the correct administration of any game laws under Indian conditions it is I think necessary that no distinction be made between forest and non-forest land. Before the Act came into operation it was not possible to take any action against a person driving into town with a Cheetal doe in his car unless it could be proved that it had been shot inside a Reserved Forest! The Forest Rules have not been rescinded and there is a certain amount of duplication of rules with respect to the forest areas.]

There is ample provision in the Act (Chapter IV) for the formation and conduct of 'sanctuaries' for wild life. But what steps have been taken to form any in the seven years since the Act was passed? The only ones that come to mind are those at Taroba in Chanda District (inherited from M.P.), Gir in Kathiawar (inherited from Saurashtra), and the Krishnagiri National Park in Salsette: the last named has little or nothing to offer as at present constituted, though it has distinct possibilities. Surely there are other areas in the Reserved Forests of the new Bombay State which could be made sanctuaries, for cannot the creation of a sanctuary be reconciled with the requirements of forestry?

[The Krishnagiri National Park is admittedly very small (about 12 sq. miles) and its administration has now passed to the Director of the Aarey Milk Colony. A preliminary attempt at the introduction of deer into the Krishnagiri National Park has not been very successful, but Grey Junglefowl released in 1952 have now established themselves and can be heard on any morning. With the closure of shooting on the whole of Salsette Island and with the opening of the new road from the Aarey Milk Colony to Kanheri it is possible that another attempt at the introduction of Sambar and Cheetal may be more successful.

The Dandeli Game Reserve in North Kanara, which was never a national park, covers an area of about 100 sq. miles and did hold a few Bison, Deer, and Elephants. This has now unfortunately gone to Mysore and it is certainly essential that Bombay should look for suitable areas to turn into national parks. Sanctuaries are really not enough as they can be demolished by a stroke of the pen. National parks should be controlled by Acts of Parliament which render them more inviolable.]

A sanctuary in India (Taroba for instance) need not be of anything like the size of its African counterpart for the type and variety of animals, which have to be protected and which incidentally are almost all forest dwellers, differ so widely from those in Africa that the proposition is basically different. A sanctuary where killing or capture is totally prohibited, surrounded by Reserved Forest where there is proper regulation of both should be ideal for the purpose in view. It should not only be easily accessible to the public but properly administered as well, and here is where the provisions of the Act or the implementation of them seem to be lamentably inadequate. For how many officers or servants of the right calibre and training have been appointed to enforce the Act?

[The lack of suitable personnel for the administration of the Act is one of the most difficult problems before us. The number of people who can identify game birds and animals is negligible and so far no attempt appears to have been made to remove this deficiency.

Soon after the Act came into operation there was a report of a man being fined Rs. 5 for shooting an 'Opossum' during the Close Season. As this animal is not known to occur in India, the Society asked for the skin which proved to be that of a Civet Cat and which is listed as Vermin and does not require any licence! In the same area another person shot a Green Pigeon and was apparently able to prove to the Court that it was a bird of prey because it had claws!]

It seems that too much is expected of a single Wild Life Preservation Officer and honorary appointees. It also seems fairly clear that it is in the Reserved Forest areas that almost all India's species of four-footed fauna can and should be conserved. This places the onus on the Forest Department for carrying out the work required and they will obviously need a reinforcement of staff at the right level to do it. Why cannot there be an entirely separate set of rules (administered by the Forest Department) governing shooting and capture in those areas of Reserved Forest which are large enough to be divided into blocks? It is on the border line between Reserved

Forest and cultivated areas that the real clash of interests occurs, so far as big game is concerned, between the interests of cultivators and conservationists. The handling of this situation to maintain a proper balance calls for skilful and authoritative administration for which an adequate executive staff is essential.

[The preamble to the Act referred to earlier reads in part:

'Recently, so many States have merged in the State of Bombay. This has increased the State-forest area considerably. In view of this it is proposed to appoint an independent officer for seeing that the provisions of the Bill are properly implemented. Forest Officers are fully engaged with their normal work and cannot find time for effectively undertaking this duty.'

In spite of these sentiments the Wild Life Officer works departmentally under the Chief Conservator of Forests and there is very little evidence of his securing any assistance, at least from the junior members of the Forest Department few of whom really understand the details of the Act and its administration.]

There remains the administration of conservation and shooting of small game (birds almost entirely) which applies outside the Reserved Forest for the most part. While the Act provides fairly comprehensively for this on paper it can hardly be said that anything like adequate provision has been made for implementation.

[Within shooting distance of Bombay, the activities of trappers appear to have been controlled, but there is little or no evidence of increase in the number of game birds like partridge and quail. I think an important factor is one to which very little attention has been given in this country, namely Cover. The denudation of the hillsides and the continued cutting of bushes and shrubs around villages has left no cover which is essential to these birds. Where some years ago two or three guns could make a satisfactory bag of partridge, no birds are now seen. It is apparent as one walks along that the cover which existed is now gone and the small islands of scrub which produced the birds which had run the whole line of the beat no longer exist. Below the Ghats we have only the Painted Partridge which seldom goes out into the open, and the removal of its natural habitat has either reduced its numbers sadly or forced it to live in new places still unlocated.]

There also appears much room for improvement of the classification in the Act under Schedule II (Small Game): for example what are 'water-birds' and what water-birds should really be treated as game birds? What in fact is a game bird or animal? Some attempt at definition seems indicated and the following is suggested:

'A game bird or animal is one which possesses the first and at least one other of the following three attributes:

(1) It should have adequate means of protecting itself by powers (or combination of powers) such as those of swift movement or concealment or detection or retaliation and the intelligence to use those powers, which make it difficult to circumvent and call for skill, patience and/or endurance in bringing it to bag;
(2) It should be notably edible;
(3) It should carry a trophy which is a worthy memento of the chase.'

[The term 'Water-Birds' was used after due consideration to include the 100 odd species of Sandpipers, Stints, Plovers, Curlews, Coot, Moorhens etc., etc., which are all shot at sometime or the other in the best shooting circles. It was thought that this general term with the specific exclusion of Egrets, Herons, and Storks would be sufficient, though it now seems necessary to add a few more like Flamingoes, Ibises, and Cormorants to the list of prohibited species. I do not think that it would be worthwhile attempting to make a list of the water-birds which can or cannot be shot.]

Finally, if people are to be allowed to shoot or capture game lawfully and have to pay for a licence or licences to do so (in addition to an arms licence) they should be given a fair money's worth. They should not be subjected to a complexity of rules, for example forest rules superimposed on Protection Act rules. In short they should be treated with some consideration.

[In spite of several efforts, I have still been unable to persuade Government to arrange to have the game licences issued against payment at the counter. It is true that some persons may be blacklisted and licences not issued to them, but no such action has yet been taken and the problem has not yet arisen.

There has been considerable discontent among shikaris over the necessity of obtaining permission to beat in Reserved Forests, particularly as most of the shooting is arranged at short notice when there is no time to obtain permission from the District Forest Officer. At a meeting of the Advisory Board held on 22nd February 1955 it was agreed that permission should be available from the Range Forest Officer and a list of these officers would be attached to game licences. It was also recommended that if the officer was not available, the applicant had only to make an entry in a book to be retained on the premises and proceed with the beating, though it was open to any forest officer to stop this should he think that this interfered with the work of his department. Unfortunately, there is yet no evidence of any action having been taken in this respect.]

On this basis (to take one instance) the necessity for Section 10, Chapter III of the Protection Act is not clear when it seems that the object of this provision could quite easily be achieved by the arms licensing authority notifying the Wild Life Preservation Officer direct of all licences granted or renewed under the Arms Act. Also both for convenience and information, could not a handy-sized copy of the Protection Act of 1951 (in the appropriate language) be issued automatically along with any licence granted initially under Section 11 of the Act? Licencees have to sign for having read it. [The Act and the Rules thereunder have been published in a handy booklet priced at 5 as.]

The above is mostly concerned with the proper implementation of what is an admirably intentioned piece of legislation. But no amount of effort towards implementation will be really successful unless there is an adequate amount of popular support. To enlist popular support, widespread education (starting with the young) and dissemination of information by every possible publicity medium is indicated. Also, most importantly, it is necessary to allay suspicions, which undoubtedly exist, of wild life conservation and hence game preservation being really designed in the interests of the well-to-do. These aspects of the matter will undoubtedly have to be tackled by private agency. But those who are public spirited enough to make the effort can surely expect to receive adequate Government support.

Nest construction technique of the Purple Sunbird

BY

JOSEPH GEORGE

New Forest, Dehra Dun

The nest of the Purple Sunbird (*Nectarinia asiatica*), one of the most wonderful examples of bird architecture, has been described by many ornithologists. Hume (1890) has given the following exhaustive account: 'The nest is pendent, and composed of all kinds of materials beautifully woven together with the silkiest fibres and cobwebs; hair, fine grass, pieces of decayed wood, lichens, rags, thorns, etc., are all pressed into service. The body of the nest is oval, generally, with all sorts of little pendent pieces of wood, etc., hanging below as ornaments, apparently, while the apex of the oval is prolonged into a cone meeting the point of support. A little above the centre of the oval, a small circular aperture is worked, and just above it a projecting cornice, 1 to 1½ inches wide, is extended; then on opposite side of the oval, the wall of the nest, which is ready some days before the eggs are laid, is pushed out or bulged out a little so as to give room for the sitting bird's tail. The bulging out of the back of the nest is one of the last portions of the work, and the female may be seen going in and out trying the fit, over and over again.'

Hutton, a correspondent of Hume (1890), observed that the materials of construction are not interwoven, but held together by cobwebs and seed down sparingly plastered over the other materials, and most abundant at the point of attachment to the twig from which the nest is suspended.

Adam, another correspondent of Hume (1890), found that on the second day after beginning of a new nest, it had the upper portion well formed, on the third day the nest was well blocked out, but had no inner lining, and from the fourth day to the seventh, the bird was occupied in ornamenting the outside of the nest with all sorts of stray feathers and other odds and ends. During these days it also filled in the inner lining. On the ninth day Adam found the bird sitting in the nest, presumably on eggs.

Gill (1924) has briefly described the different stages in the construction of the nest as observed in the plains of U.P. From the point of suspension, he states, the nest is gradually extended and widened till the place where the aperture should be is reached, the nest having acquired by this time the shape of a more or less solid cone with the apex on top. Now comes the aperture with the little projecting cornice above it. Next, the bird extends the body of the nest and finally the soft and cosy egg-compartment. Then follows a short period of activity during which the female may be seen going in and out of the nest, twisting her little body about inside it in order to get the pliable materials to conform to the shape of her body; and, as she sits in the nest with her bill protruding from the aperture, it acquires a distinct bulge behind in order to accommodate her tail in comfort. Gill found that the nest took about 10 days to complete.

Bates has recorded the different stages in the construction of two nests. The first nest (Bates, 1926, 1931) in a Madras garden, the construction of which he saw from its commencement, took a full three weeks to build. On the fifth day the nest had progressed to the extent of being in shape not unlike the upper half of a crinkled paper bag suspended from the branch or a small edition of an unfinished weaver-bird's nest without the cross bar. On the twelfth day this outer shell was almost completed and reminded him of nothing so much as of a deflated penny balloon, the entrance hole appearing like a rent in its side.

The next step appeared to be the construction of the porch, and by the sixteenth day this and the outer shell were altogether finished, even down to the ragged little bits hanging down an inch or so below the nest on loose strands of web. After this no further work was done on the outside. During the next week the 'balloon' was quickly inflated, the bottom presenting a more or less rounded appearance on the afternoon of the seventeenth day.

The second nest, observed by Bates (1927, 1931) in Pachmarhi, was completed within six days. The first day's work resulted in a stalk some 3 inches long which just showed signs of a division in its lower portion from which, Bates thought, the sides were eventually to be formed. On the second day great progress was made, as the entrance and porch were completed and also the sides, front, and half the back, leaving as the third day's task but the bottom and lower half of the back premises to be added. By the afternoon of the third day the female had actually commenced the filling. Three days more and the nest was finished.

The method of construction of the second nest was, according to Bates, virtually the same as that of the first nest he described. The outside was completed in every detail before the filling and lining was put in hand. The so-called decorations, he remarks, are component parts of the outer case and, far from being additions which might easily be dispensed with, are, or rather those not merely suspended from the structure are, important solid portions—foundations—of the main framework.

Later in the same year, Bates (1931) observed the construction of a nest by the Purplerumped Sunbird (*Nectarinia zeylonica*). The female Sunbird wrapped building materials round a drooping twig causing the loose ends to project on either side of it. These projections were gradually increased, bent round, and brought together, so that the shell was thus formed of two more or less separate halves joined together from below the entrance hole.

If the second Purple Sunbird observed by Bates had adopted such a technique, that is, if it had lengthened the two halves of the stalk and joined them together from below the entrance hole, its method of construction would have been different from that of the first bird which had initially built a small edition of an unfinished weaver-bird's nest without the cross-bar, or in other words, a bell shaped structure.

Lowther (1949) saw a female Purple Sunbird flying from one bush to another one morning prospecting for a nesting site. As soon as a site was decided upon she busied herself with nest building. The following morning Lowther found the bird making 40 visits to the nest in 40.5 minutes and 50 in 60.5 minutes. At 8.15 a.m. the visits to the nest slowed down appreciably and from midday till 2.30 p.m. she did not go near the nest. On the evening of the second day the pendent home was found to have been roughly fashioned, even down to the entrance hole. The nest held the first egg on the sixth day after construction began.

It has been the experience of different observers that the nest of the Purple Sunbird is the work of the female alone. (Sálim Ali, 1955). Lowther (1949) has, however, come across three instances of the male assisting in the task 'at nests each 200 miles apart'. In one case the male bird's contribution was about 25 per cent, in the second about 50 per cent, while in the third only the male proceeded with the construction during the two days following a great fright which the female received as she left the nest.

Hutson (1954) saw 3 female sunbirds at work on their nests. At the time of observation one bird which was reducing the size of the entrance, which was too large, was never at the nest longer than 10 seconds and was often away for over a minute. The second bird was at the nest 5 to 8 seconds at a time and away for 20 to 25 seconds, while the third one merely stayed long enough to poke in what she had brought before flying back for more.

The writer (1957) had a rare opportunity to observe the construction of a nest by the Purple Sunbird in his bungalow. This was followed by observations on the construction of a few other nests during the nesting seasons of 1957 and 1958 in New Forest, Dehra Dun, U.P. It is possible from these observations to form a complete picture of the operations involved in nest building. It would be interesting to find out, especially in view of Bates's observations, whether the technique followed by the birds in Dehra Dun is the same as that followed elsewhere. Lowther's observations on the participation of male sunbirds in nest construction also show the possibility of variation in nest construction habits.

METHOD OF NEST CONSTRUCTION

The observations in Dehra Dun show that while all the birds followed the same technique of nest construction, there was a certain amount of variation in the timing of the different operations involved, as also in the number of times a particular operation was carried out. Extracts from the field notes on the construction of three nests are given at the end of this paper. These notes show the similarity in technique of construction, and at the same time serve to bring out the differences referred to above.

First day's work: Nest construction always began in the morning. On the morning of the first day, male and female birds together examined different sites and chose one. Prospecting for a nesting site appeared to begin on the day previous to this or even earlier. Bates (1931) found a pair of Purplerumped Sunbirds becoming interested in their nesting site 10 days before construction began. The female Purple Sunbird was often observed to wind cobweb at more than one site before the pair made the final decision about the nesting site. The female, who alone was found to build the nest, alighted on the chosen twig to fix the material she brought. Later on, she alighted on the nest stalk as it took shape. Some material was also fixed while hovering. The female bird was never seen coming to the nest without building material except during the first visit or first few visits in the mornings.

When nest construction began, one bird confused between two sites that were similar in appearance and close to each other on the same twig. Work proceeded simultaneously at the two sites for some time before the bird mastered the situation and built at one site alone. In one instance two strands were built close to each other at a site to support the nest. When the nest was suspended from a sloping twig, a considerable length of the latter was usually built over. One nest built on an almost vertical stem of a climber was attached to it for a length of about 6 cm. The nest was loosely attached to the stem for a further distance of 12 cm. Bates (1931) found a Purple-rumped Sunbird wrapping building materials to a distance of 5 to 7.5 cm. on a twig drooping at an angle of about 60°. In the case of the nest built on a pendent chain (George, 1957) about 13 cm. of the latter was built into the nest. Another nest was loosely attached throughout its whole length to a vertical stem of a climber.

The next development in nest construction was to poke the nest stalk with the beak at a point about 3 cm. to 7 cm. below the point of suspension. The poking was done during several visits to the nest, but usually only once per visit. Occasionally, material brought to the nest was pushed in at this point with a vigorous thrust. In one nest the fibres around this point showed a circular orientation by 11 a.m.; in some other nests orientation was visible by the evening; in yet others, especially where leaves were used in abundance, no orientation was observed. At the end of the first day the nest stalks were found to be from 5 cm. to 15 cm. in length with a tail up to 15 cm. in length. The stalk was often shaped like a gently tapering cone with the apex at the top.

Second day's work: On the second day more material was added to the nest stalk. Poking was continued, but the head itself was now pushed into the mass of materials. Eventually a depression appeared at this point if the nest stalk was very bulky or a hole appeared if the nest stalk was fibrous and thin. Starting from the same point, the direction of the push was now changed up to about 75° to the left and right. The material at the back of the stalk got spread out and the beak of the bird and, later on, its head came out on the sides and back of the nest. The spreading out of the materials at the back and sides of the nest stalk was the first step in the formation of the pouch. The wall so formed was very flimsy at this stage with a big hole in the middle, opposite the point at which the bird started pushing, and many other smaller holes and gaps. The hole in front at the point of pushing became the entrance hole to the nest.

The addition of material to the nest went on, but much of it was now pushed in through the entrance hole. The bird continued to enter forward into the entrance hole, but it now also pushed upwards with partly lifted wings. It then backed out. The hole was enlarged by this operation. Standing on the lower rim of the opening, the bird also pushed up the top rim with its crown. As a result of these pushing operations the hole assumed an oval shape and was larger than the entrance hole of the finished nest in length. When the bird pushed up with partly opened wings, it stretched its legs apart on the lower rim. The whole mouth of the nest was in tension during this operation and elongation of the hole took place both upwards and downwards.

The pushing in of material into the hole continued and the material was further pushed back by the head as described earlier. The wall of the nest got strengthened and the hole at the back was nearly closed in some nests. At this stage the bird carried out a very interesting operation to smoothen the sides of the entrance hole. It lifted its hind parts up to one side and pressed the material on that side of the opening with its tail, using the underside of the tail for the purpose. The operation was carried out on both sides, now on one side, now on the other. The tail was sometimes lifted well above the head for this operation.

A move to force down the bottom of the nest to enlarge and lengthen it into a pouch also began at this stage. The bird entered the nest and with a vigorous shaking movement of its body, sank into the material at the bottom.

Another interesting move was made to smoothen the lower rim of the entrance hole. The bird entered the nest, turned about and put its head outside the nest. The head was then bobbed up and down so that the throat pressed the rim. The bird moved left and right to cover the whole rim. If some point of the rim was misshapen this head bobbing was sometimes restricted to that point only.

Third day's work: On the third day the bird continued to push the top of the opening with its crown and partly lifted wings. Pressing the rim of the opening with the tail and throat, and forcing the bottom down to lengthen the pouch were also continued. In those nests where the back wall of the nest was slow to form, these operations were begun only on the third day.

The construction of the cornice and the lining of the pouch were taken in hand on the third day. The former was completed on the fourth day, while the latter was continued till the bird was ready to lay. Most of the lining work was, however, done on the third and fourth days.

A move to consolidate the materials of the wall and to bulge it out further was begun on the third day and continued on subsequent days. The bird entered the nest, remained inside in various directions and pushed the wall backwards with the underside of its tail. The point that was pushed could be seen shaking and bulging out on the outside. The wall of the nest is very pliable, so that when the bird stopped pushing, the bulge disappeared. The directions in which the bird pushed with its tail were the same as those in which it pushed with its beak and head earlier on the second and third days. In addition, the bird took up positions at right angles to the direction it occupies while incubating and pushed out the wall on the left and right of the entrance hole.

It is interesting to compare these actions of the Purple Sunbird with the corresponding actions of the Yellowbreasted Sunbird (*Nectarinia jugularis*), so vividly described by Loke (1954) who observed the bird at work in his garden in Singapore. Every so often, the female Yellowbreasted Sunbird would sit inside the nest and turn in a circle with the object of rounding out the lower half of the nest chamber. Sometimes she would sit with her beak projecting out of the entrance and with wings slightly opened would move vigorously from side to side pushing out the walls of the nest.

The hole in the back wall sometimes became larger as a result of the tail movements of the Purple Sunbird. Material added subsequently usually closed the hole again.

Very little material was added to the exterior of the nest on the third day. On the fourth day it was done only once or twice. On subsequent days there was no addition at all.

Fourth day's work: Work on the cornice and the lining of the pouch continued on the fourth day. The lining material was smoothed down by the shaking and sinking movement. The wall was pushed on all sides with the tail. The bird also pressed against the sides of the wall with its body. Hume's expression 'trying the fit' may be taken to mean all these operations together.

The wall of the nest sometimes developed holes even on the fourth day when the bird was trying the fit. These holes were usually closed with material added later, but small holes remained in the finished nest sometimes.

The upper end of the oval opening was built over in making the cornice. The sides received on very rare occasions some material to strengthen them. The lower rim became thickened by the material added on the inside of the nest and by the ends of fibres pulled in from the outside of the nest by the bird. The result of all this was that the entrance hole became more or less circular in shape.

Fifth and subsequent days' work: Lining of the nest continued on the fifth day. No other material was added to the pouch but fibres sticking out in front were pulled in through the entrance hole and the entrance smoothed out by the tail if found necessary. The front side of the nest was sometimes further tidied up by pushing loose projecting ends of fibres into the body of the nest.

A certain amount of work was done on subsequent mornings till the first egg was laid. This consisted in adding more lining material and trying the fit. The first egg was laid on the eighth or ninth morning after commencement of construction. The second egg followed on the next morning and the third egg, if laid, the morning after.

The 'tail' of the nest: The tail seen hanging below many nests was partly built by the bird and partly accidental. Loose strands of cobweb brought by the bird or already existing at the site 'collected' material falling off the nest. The bird sometimes also fixed material quite low down on these strands of web. There appeared to be a tendency for the bird to 'dump' large size material in the tail region. In one instance the tail was contiguous with cobweb already existing below the site so that the tail appeared to have been joined to a bush lower down. However, this connection was not as conspicuous as the one photographed by Bates (1927, 1931). It is interesting to recall Jerdon's (1877) observation of two nests being built at sites where cobweb already existed.

Collecting material for the nest: For gathering cobweb for the nest, the bird was observed to take hold of one strand after another while hovering, and fly off. For bark, the bird alighted on a suitable stem and tore off piece after piece, some pieces dropping off during the process. Most of the material was collected after alighting at suitable places. Sometimes the bird also tried with little success to snap off grass stems, etc., while hovering.

Orientation of nests: At a very early stage in the construction, it became clear that the bird invariably made the approach to the nest from the same direction. This was the direction in which the opening of the nest eventually faced. The bird did all the work on the nest from the entrance hole side. For fixing material at the back, she stretched her body out over the side or even the top of the nest. It may be worthwhile recording that out of 24 nests observed in 1957 and 1958, 13 nests faced west while only 7 faced north and 2 each faced east and south.

ACKNOWLEDGEMENT

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Observations on the Vegetation of the Rampa and Gudem Agency Tracts of the Eastern Ghats*

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(*With two maps and five text figures*)

The Rampa and Gudem Agencies, as they were formerly known, are located along the Eastern Ghat ranges of the Godavari East and the Visakhapatnam districts of Andhra Pradesh (long. 81° 30′—82° 15′E. and lat. 17° 15′—18°N.). The forests of these tracts which are occupied by the hill tribes, ' Konda Dora ' (or ' Koya ') and ' Konda Reddi ', have been very little explored. A part of the Gudem Agency tract which now lies in the Visakhapatnam district near the boundary of the Godavari East district was first visited by Col. R. H. Beddome of the Madras Forest Department in 1840. Later in 1883 and 1884 J. S. Gamble of the Madras Forest Department explored the forests along the Godavari River which include the Rampa Agency. In 1902 C. A. Barber of the Madras Forest Department again visited the Rampa Agency and other surrounding parts of the lower Godavari. Afterwards, in 1914, M. S. Ramaswami of the Botanical Survey of India collected a few specimens from the Rampa area only. A. W. Lushington visited a part of the Gudem area of the Visakhapatnam district during his collection tours in the early part of this century. The same area and the surrounding tract were next visited by V. Narayanaswami of the Botanical Survey of India in 1920. Again, in 1947, a general survey of the parts of the Rampa and Gudem areas and also the wide area in between the two zones was undertaken by V. Narayanaswami and the research party of the Botanical Survey of India including the writer. Afterwards, in 1949, the writer had the opportunity of studying the Rampa and Addatigala Agency forests in further detail.

The Rampa and Gudem Agency tracts occupy hilly regions adjoining the plains of Godavari East district and the south-west border of the Visakhapatnam district with the boundaries of the Godavari River on the west, the Sileru River on the north, the major portion of the

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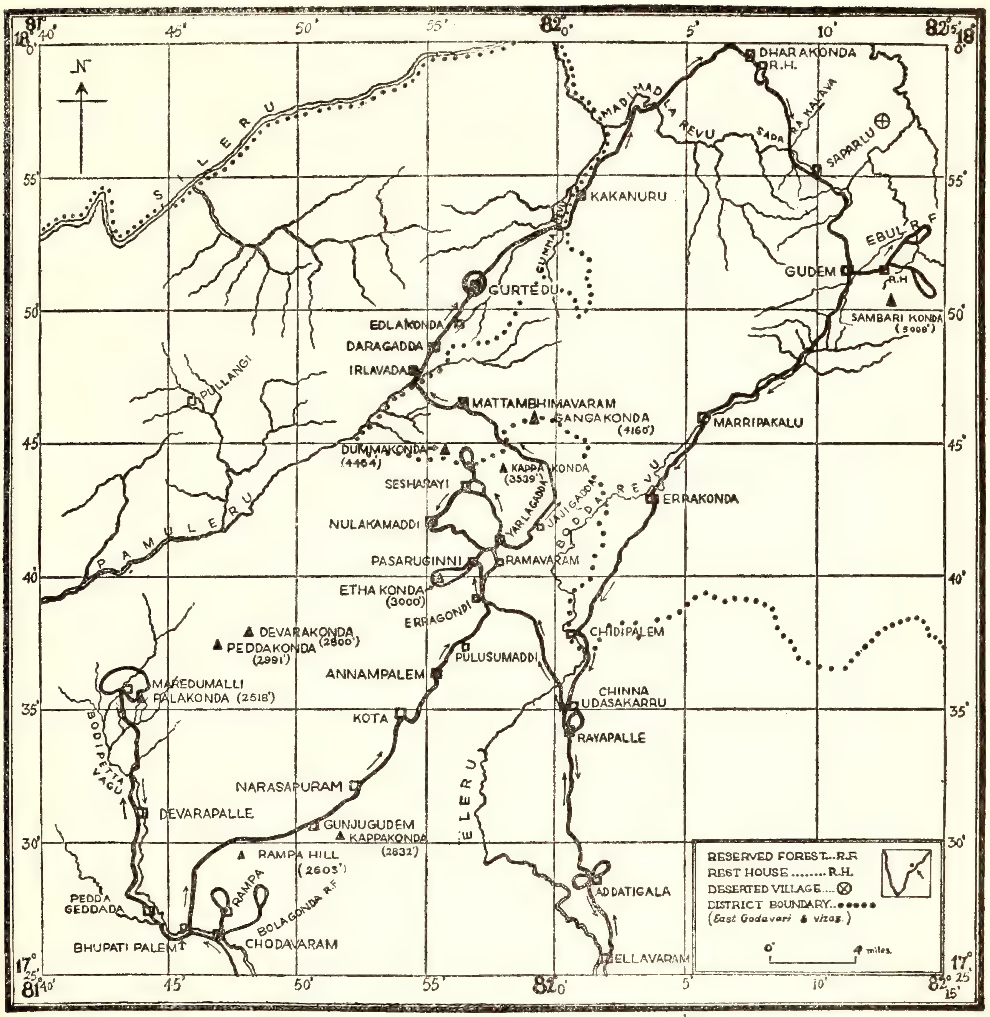
* The paper was written when the author was working at the Calcutta Herbarium and was read at the symposium on ' Vegetation Types of India ' held during the 42nd session of the Indian Science Congress at Baroda in Jan. 1955.

Chintapalli taluq of Visakhapatnam district on the east, and the plains of the Godavari East district on the south. It covers an area of about 3000 sq. miles ranging from long. 81° 30′ to 82° 15′ E. and lat. 17° 15′—18°N. The ghats in this area rise by gentle gradations with an average altitude varying from 500 ft. to 4000 ft. The elevation of the Rampa country adjoining the Godavari River gradually increases from Chodavaram (30 miles north-east of Rajahmundry) and the general altitude of the area is about 1500-2000 ft. (450-600 m.). The highest point in this region is Bison Hill with an altitude of 2708 ft. (825 m.). The hills are highly dissected. The elevation from the bank of the Godavari gradually increases towards the north-east with an average altitude of about 2500-3000 ft. (750-900 m.). The highest peak in this part of the Rampa region is Dummakonda with an altitude of 4466 ft. (1361 m.). Further north-east in the Gudem area of Chintapalli taluq, Visakhapatnam district, the highest point is Sambar hill with an elevation of 5009 ft. (1527 m.). This north-eastern part of the Rampa and Gudem areas contain moist valleys with dense primeval forests and small tributaries of the rivers Sileru and Eleru running along the various gorges and valleys. The hills throughout the region under study are covered with dense forests along the slopes and present characteristic barren tops where mostly grasses and a few herbs grow. (Map 1).

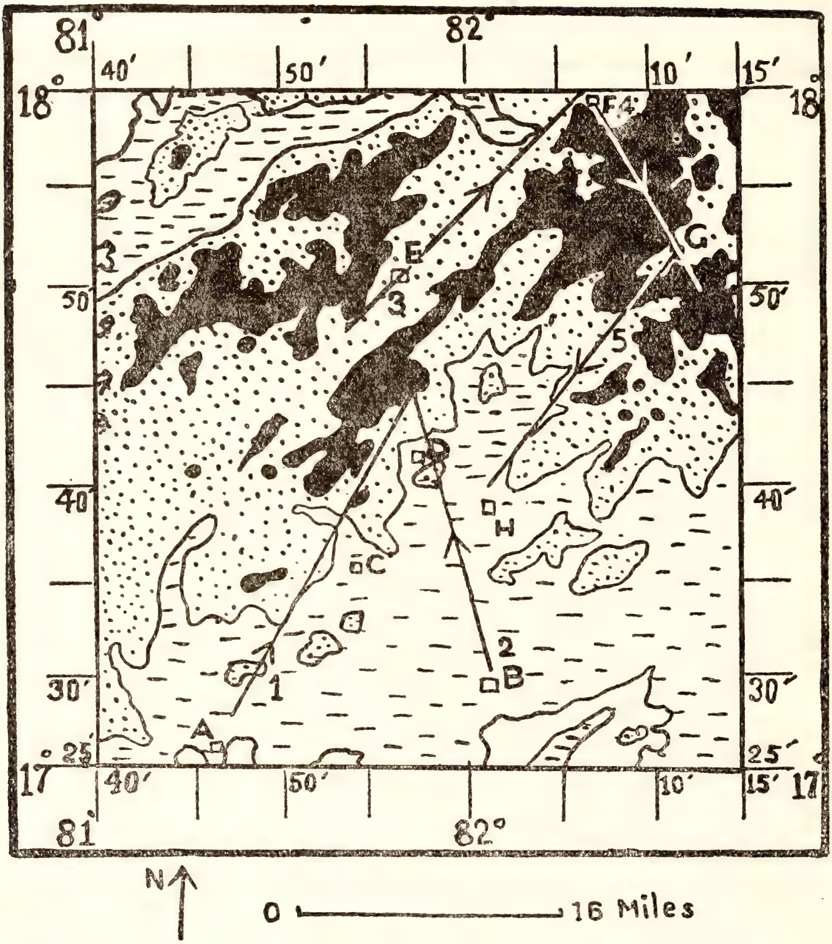
Geology

The Eastern Ghats, consisting chiefly of crystalline metamorphic rocks, have a strike north-east—south-west with various parallel structural ridges running in the same direction. Young valleys are opened up by subsequent tributaries like the Pamuleru of the Godavari River and the Maddieru of the Eleru. The region is an uplifted peneplain. The chief rock types of the area are khondalites and charnockites, the former group including garnet-biotite-gneiss (Musurumilli and near Addatigala), garnetiferous gneiss (widely distributed), garnetiferous quartzites (Seethapalli hills), and garnet-sillimanite-gneiss.

The area from Rampa to Gudem consists of different types of soils. Lateritic soil is the common type along the deciduous forests of the area. But along the plains and valleys adjoining the rivers Pamuleru and the tributaries of Eleru there is a certain amount of black cotton soil partly mixed with coarse sandy loams. At certain places the hill-sides are usually covered by stony and gravelly soil which is sometimes highly leached. The hill-tops on Bison Hill, Dummakonda, Sesharayi, Dharakonda, and others, which are almost barren with grasses and other minor herbs, usually present huge boulders and highly denuded rocky surface. Hot springs with a few sulphur deposits along the huge cut-end portion of a hill-slope near Sesharayi have been observed.


N
SILERU
MADIMADLA REVU
DHARAKONDA
R.H.
SADA
RAKALAVA
SAPARLU
KAKANURU
GUMMA REVU
EBUL R.F.
GUDEM
R.H.
SAMBARI KONDA (5000')
GURTEDU
EDLAKONDA
DARAGADDA
IRLAVADA
PULLANGI
MATTAMBHIMAVARAM
GANGAKONDA (4160')
MARRIPAKALU
DUMMAKONDA (4464')
KAPPAKONDA (3539')
SESHARAYI
BODDA REVU
ERRAKONDA
NULAKAMADDI
YARLAGADDA
JAJIGADDA
PAMULERU
PASARUGINNI
RAMAVARAM
ETHA KONDA (3000')
ERRAGONDI
DEVARAKONDA (2800')
PEDDAKONDA (2991')
CHIDIPALEM
PULUSUMADDI
ANNAMPALEM
MAREDUMALLI
PALAKONDA (2518')
CHINNA UDASAKARRU
BODIPETTA VAGU
KOTA
RAYAPALLE
ELERU
NARASAPURAM
DEVARAPALLE
GUNJUGUDEM
KAPPAKONDA (2832')
RAMPA HILL (2603')
RAMPA
PEDDA GEDDADA
BOLAGONDA R.F.
ADDATIGALA
BHUPATI PALEM
CHODAVARAM
ELLAVARAM
RESERVED FOREST...R.F.
REST HOUSE........R.H.
DESERTED VILLAGE....⊗
DISTRICT BOUNDARY..●●●●●
(East Godavari & Vizag.)
0 4 miles
81° 40'
45'
50'
55'
82° 0'
5'
10'
82° 15'
18° 0'
55'
50'
45'
40'
35'
30'
17° 25'

Map of Rampa and Gudem Agency tracts, showing the route followed and regions surveyed.


81°
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17°
81°
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16 Miles

Map of Rampa and Gudem Agency tracts, showing the variation in altitude and distribution of vegetation. (Position of the five transects studied are also shown.)

Cultivated lands: ☐ below 500′; Transitional: ▤ 500′ — 1,500′; Dry Deciduous: ▨ 1,500′ — 3,000′; Moist Deciduous: ■ 3,000′ — 5,000′.

A. Chodavaram; B. Addatigala; C. Kota; D. Ramavaram; E. Gurtedu; F. Dharakonda; G. Gudem; H. Chidipalem.

1. Rampa to Dummakonda. 2. Addatigala to Dummakonda. 3. Daragedda to Dharakonda. 4. Dharakonda to Gudem. 5. Gudem to Chidipalem.

CLIMATE

The climate on the hills of Rampa and Gudem is mild in summer and in some of the interior valleys of Gudem the winters are very chilly. The maximum shade temperature rarely exceeds 100°F. even in May. The valleys of Rampa and Dummakonda areas are quite hot and less humid, but the valley in between Dharakonda and Gudem is cooler and more humid. Frosts occur at higher elevations.

The general rainfall for the area as a whole ranges between 45″-55″. The rainfall shows a tendency of gradual increase from the Rampa area (south-western portion of the region under study) to the Gudem area. In places like Chodavaram, Addatigala, and the neighbouring areas with an altitude of about 1000 ft. (300 m.), the average rainfall is 45″. This average gradually increases towards Dharakonda, Gudem, and Jeypore Agencies of the Visakhapatnam district where the average rainfall is about 55″. The highest rainfall of 86.02″ was recorded in 1893 at Chodavaram (about 1000′). It is a pity that no data of temperature and rainfall from the hill-tops of the area under study are available. But the general averages of the various places given above can be safely considered as appropriate as they are based on the data available from the adjoining regions of the Rampa and Gudem areas. But the rainfall is not evenly distributed throughout the year. Usually in June-July and in October and November these areas get the heaviest rainfall from the south-west monsoon and north-east monsoon respectively. July is the month of maximum rainfall (10″).

The flora itself reflects the climate. The general vegetation is mostly a dry deciduous type except in the valleys of higher elevation where it is more moist. But in Gudem valley, there are patches of dense forest with a network of small streams which indicate the formation of moist evergreen type to a certain extent. In general, ferns are rare in number and few in species except in the Gudem valley. Similarly the epiphytic orchids are scarce in most of the lower elevations but they appear quite common along the valleys of higher elevation and the Gudem valley. Though the total annual rainfall is considered as moderate, it is noted that its distribution throughout the year is very uneven. Thus, the climate of the area under study is almost dry from December to May, the average monthly rainfall during these seven months being very little. This absence of a heavy rainfall combined with moderate temperature and rather prolonged cold season from November to March tends to favour a flora of not very moist type, a fact which is evident from the list of plants given at the end. The effect of frost is probably not very severe in the plants growing on the plateaux and other open areas. But usually it kills the saplings and other secondary growth and this causes delay in the recolonisation of the grass-lands and forest-cleared areas by trees and shrubs. As the frost is not so severe as to inhibit growth completely, young seedlings become slowly established under the protection afforded by the larger trees along the fringe of the closed forest, thus gradually extending their range.

Another factor, which cannot be entirely overlooked and which also adversely affects the process of recolonisation, is the high winds that sweep across the plateau lands and the barren hill-tops at certain periods of the year, particularly during the months of March and April and also during the cyclonic months October and November. The high winds that blow during the hot season, with their dessicating effect on the vegetation that grows on the hill-tops with only thin soil-covering and little soil moisture, give no chance at all for the plant growth and are thus responsible to some extent for the development of barren hill-tops along the Dummakonda and other neighbouring ranges.

BIOTIC FACTORS

The people inhabiting these Agency areas are mostly 'Konda-Reddis' and 'Konda Doras' (Koyas), the two hill tribes found on either side of Godavari from the point where the Indravathi joins it down to the borders of the plains and extending as far as Jeypore Agency towards the north-east. These tribes have settled down in these areas and taken to cultivation for many years. During former times, before the reservation of forests, they indulged extensively in shifting cultivation called *podu* by clearing and burning the forests. The two methods of cultivation followed by them are the ordinary (or *chālaka*) *podu* and the hill (or *konda*) *podu*. The former consists in cultivating certain cleared areas for a year or two, then allowing the forest to grow again for a few years and again burning and cultivating those areas. Under the latter, the clearing is not returned to for a much longer period, and is sometimes deserted for ever. By this method of making clearings in the heart of the forest by felling and burning the trees, cultivating them for a year or two until their first fertility was exhausted and then moving on to new ground, and also by the fires lit for burning these patches spreading over surrounding areas, extensive tracts of the forests were ruthlessly destroyed. Many deserted villages were observed along the track followed by the Botanical Survey of India's field party. It is only after the strict enforcement of forest rules and reservations that this destructive method of raising crops has been controlled to some extent. Due to the conflict between the interests of the tribes and those of forest conservation, and also due to the violent rebellion in Rampa and Gudem Agencies, some of the well-recognised *podus* and certain cultivable areas were excluded from reservation and handed over to the people for rotation and extension of cultivation.

But there are certain zones in the Gudem valley appearing to be practically uninhabited and also unreserved and thus remaining as primeval forests uninterfered with by the human agency.

Another important factor with a considerable influence on the vegetation of the area is the grazing of cattle brought by professional graziers, particularly during the summer and monsoon months, in the Rampa area adjoining the plains. Such grazing is less common in the interior.

The effect of these two main factors, namely *podu* cultivation and seasonal grazing on the original vegetation coupled with denudation of the soil by heavy rains on certain cleared hill slopes, has been sufficient to reduce a great part of the forest to mere grass-lands or to an open dry deciduous jungle. Some of the plateaux and uplands in between the plains and the actual hilly tracts which were once subjected to destructive methods of raising crops and which are now seasonally attacked by grazing cattle or by fires created by graziers present a deserted appearance with dry eroded soil, huge weathered rocky boulders, and a few spiny bushes and stunted trees here and there.

The villages of ' Doras ' (Koyas) and ' Reddis ' are mostly situated in the valleys or on the uplands adjoining the hills. The rice cultivation in flood plains and other areas with black cotton soil occurring along the tributaries of Pamuleru and Eleru Rivers, mostly depends on rains. A few pulses, like arhar (*Cajanus cajan*), mung (*Phaseolus radiatus*), green gram (*Phaseolus angularis*), are also cultivated on and along the rice fields as a second crop. In other areas with laterite soils where only dry cultivation is possible, small millet (*Panicum miliare*), ragi (*Eleusine coracana*), jonna (*Andropogon sorghum*), ganti (*Pennisetum typhoideum*), are mostly grown. In the villages a few climbers of Papilionaceae and Cucurbitaceae such as ' bean ' (*Dolichos lablab*), dosa (*Cucumis sativus*), and other allied species are grown. Tobacco is cultivated on the dry patches near about the rice fields of Yarlagadda village. Tamarind (*Tamarindus indica*) and mango (*Mangifera indica*) trees are very commonly grown in and around the villages. Particularly in regions near Ramavaram and Yarlagadda, there is abundant growth of tamarind trees which yield quite a good revenue to the villagers. Jak trees (*Artocarpus integra*) are also grown in this area. At Gujjumamidivalasa and the neighbouring areas, ' kamala ' (*Citrus reticulata* Blanco) and musambi (*Citrus sinensis* (L.) Osbeck) are well grown. As early as 1898, one Mr. Brodie tried to introduce coffee (*Coffea arabica*) plantations in the middle Pamuleru valley and supplied seeds to the local people, but the results were not favourable. There are a few plantations still near Pullangi which are only of subsistence type. Similarly near Gudem in the Visakhapatnam district, coffee plants are grown on a small scale round about the villages. Sago palms (*Caryota urens*) were once very abundant in the Rampa and Ramavaram areas, but most of them were cut down for removing the soft delicious pith which was used as the main food by the hill tribes during the famine years.

Sugary sap extracted from these palms is usually fermented and used as an intoxicating drink. Such drinks are also prepared from ragi (*Eleusine coracana*) and sometimes from rice. Higher up in the Bhadrachalam area and towards the north-east, in the Jeypore Agency, 'ippa' (*Madhuca latifolia*) grows in abundance and the sweet fruit is used mainly for the preparation of a delicious intoxicating drink.

A Brief Note on Vegetable Resources of the Area

Various species of *Terminalia*, *Xylia*, *Dalbergia*, *Anogeissus*, *Pterocarpus*, *Lagerstroemia*, *Adina*, and a few others yield a useful type of timber, and there is some possibility of cultivation of *Tectona grandis* in certain localities of the region. A few minor forest products, such as fibre from leaves of *Caryota*, *Agave*, *Sanseviera*, *Sterculia*, *Helicteres*, *Bauhinia*, and a few others, floss from *Salmalia* and *Cochlospermum*, tans and dies from *Cassia* and *Terminalia* species, gums from *Pterocarpus* (' Gum kino ') and *Cochlospermum* (' Katira gum '), and a few drug plants including seeds of *Strychnos* have been of considerable utility. Along the edges of streams and the surroundings of Rampa hill, aromatic grasses, such as *Cymbopogon coloratus* with a characteristic smell of Citronella oil, and *Vetiveria zizanoides* producing the well-known khus-khus roots, are available, and these can be economically exploited for the development of essential oil industry in that area. Further, experiments to cultivate other grasses, such as *Cymbopogon nardus* the typical ' Citronella oil grass ', and other allied species yielding different essential oils, in order to find out the suitability of the area for extensive cultivation of such species are worth trying. Besides these grasses, wild growth of *Nyctanthes arbor-tristis* in the Rampa area and also in different areas towards the north-east (between Yarlagadda and Gurtedu), whose deliciously scented flowers are well known for their essential oil contents, is an important feature worth study in connection with the development of the essential oil industry in this area.

It appears that the excellent resources of dense growth of bamboos particularly *Dendrocalamus strictus* all along this region have not been so far utilised in the best interests of paper manufacture, which is being carried out by the paper mill at Rajahmundry the nearest city to this area. A general survey of the distribution of different species of bamboos in this region should be carried out and the introduction of better types of bamboos best suited for good paper production should be tried on the various hill slopes of this region. The means of transport by land and by water can be worked out when this area becomes a suitable land for such large-scale cultivation of better varieties.

An interesting item of cottage industries can be developed among the women folk of the hill tribes by utilising the commonly growing grasses such as *Saccharum spontaneum* and *Pollinidium binatum* for making attractive mats, baskets, chiks, and other similar articles which will have a good market in neighbouring towns.

Further, introduction and systematic cultivation of Cape Gooseberry (*Physalis peruviana* Linn.), a promising bush-fruit which has already been found to be very successful and profitable in Araku valley (3000 ft.) adjacent to the Gudem Agency, and also other hill fruits and beverage crops like coffee and cocoa, spices like pepper and ginger in the hilly tracts, and mango, citrus, banana, jak, guava, sapota, and cashewnut on the surrounding plains, and several medicinal plants indigenous to this hill country, and also planning for the exploitation of other horticultural resources of Agency areas should form the important aspects of the economic programme envisaged by the Government of Andhra for the uplift of the tribal people of the Rampa and Gudem Agency tracts.

VEGETATION

The vegetation of the region under study, i.e. the region starting from the dry cultivated laterite plains to the hills extending up to the Sileru River as the northern boundary, can be divided on the basis of climate, topography, and soil into two major vegetational zones : (*i*) the transitional zone with a mixture of thorny-scrub and dry deciduous forest types of vegetation, and (*ii*) the deciduous forest zone. (Map 2).

(*i*) The Transitional Zone : This zone comprises the transitional vegetation, showing a mixture of the thorny-scrub type and the dry deciduous forest type with, however, a few laterite fields here and there which are under dry cultivation. In this zone, there is a gradual development of different species of shrubs and trees which at the beginning form into a thorny-scrub jungle consisting of xerophytic species, such as *Zizyphus mauritiana*, *Z. xylopyra*, *Alangium salvifolium*, *Randia brandisii*, *Dodonea viscosa*, *Maba buxifolia*, *Cassia occidentalis*, *C. auriculata*, *Acacia sundra*, *Jatropha curcas*, *Annona reticulata*, and grasses like *Aristida setacea*, *Eragrostis unioloides*, *Themeda triandra*, and climbers like *Derris scandens*, *Acacia caesia*, and a few others. Subsequently, the thorny species are replaced by plants which are bushy and stunted thus giving an appearance of the formation of an open dry deciduous forest here and there. This zone occupies a considerably small region beyond Tunnuru Reserve Forest, Musurumilli Reserve Forest, Chodavaram, and Addatigala to Kota and Ramavaram. The vegetation exhibits a sparse growth of scattered bushes of *Dendrocalamus strictus*, *Diospyros pere-*

grina, *Strychnos nux-vomica*, *Cochlospermum religiosum*, *Garuga pinnata*, *Grewia tiliifolia*, *Euphorbia neriifolia*, *Casearia tomentosa*, *Holarrhena antidysenterica*, *Morinda tinctoria*, *Semecarpus anacardium*, *Webera corymbosa*, *Woodfordia fruticosa*, climbers such as *Capparis zeylanica*, *Atylosia scarabaeoides*, *Bauhinia racemosa*, *B. purpurea*, and grasses like *Aristida setacea*, *Themeda tremula*, *T. trianda*, and such others. The soil in this region is mostly laterite mixed with gravel and sand and the rainfall is about 45″. Approximately the 1500-foot-contour can be considered as the northern boundary of this zone.

(*ii*) The Deciduous Forest Zone: This zone can be conveniently divided into (*a*) dry deciduous forest which covers the various hilly tracts ranging between 1500 feet to nearly 3000 feet, and (*b*) moist deciduous forest which occurs here and there as pockets in the northernmost part of the region under study where the altitude increases beyond 3000 feet with warm moist valleys.

Dry deciduous forest: The region starts from Pedda-gaddada, Maredumalli, Palakonda, and Devarakonda through Rampa and Bolagonda Reserve Forests and proceeds towards the north-east covering the villages Gunjagudem, Kota, Ramavaram, Yarlagadda (1072 ft.), Sesharayi (2000 ft.), Mattam-Bhimavaram (2000 ft.), Gurtedu (1840 ft.), to as far as Dharakonda (1500 ft.), with various hill-tops such as Palakonda (2518 ft.), Peddakonda (2991 ft.), Devarakonda (2800 ft.), Kappakonda (2832 ft.), Ethakonda (3000 ft.), and Dharakonda Falls (2500 ft.), none of which exceed 3000 ft. (except Dummakonda hill-tops and a few others). It comprises dry deciduous forest with a variety of trees, shrubs, climbers, and epiphytes, among which the *Xylia-Terminalia-Anogeissus-Dendrocalamus* association predominates.

The region starting from Chodavaram (560 ft.) and proceeding northwards through Pedda-gaddada (750 ft.), Devarapalli (1000 ft.), Maredumalli (1285 ft.), and Etukuru (1467 ft.), along the river Bodipettavagu, flanked on either side by various hill-tops such as Palakonda (2518 ft.), Peddakonda (2991 ft.), and Devarakonda (2800 ft.), consists of dense mixed jungle with various bamboo bushes scattered all over. Rainfall is comparatively less and evaporation is great in this region, and hence the vegetation in general presents a dry appearance excepting at few points where a collection of small streams along the narrow valleys creates a humid atmosphere allowing a few ferns to grow like *Adiantum lunulatum*, *Drynaria quercifolia*, *Lastrea filix-mas*, *Hemionites arifolia*, and others. Generally speaking, the whole vegetation presents a dry bushy appearance with *Dendrocalamus strictus* as the prominent species. Trees such as *Pterocarpus marsupium*, *Aglaia roxburghiana*, *Strychnos* *potatorum*, *Dalbergia* and *Terminalia* species, *Tectona grandis* (often cultivated), and shrubs such as *Polyalthia suberosa*, *Grewia abutilifolia*, *Olax scandens*, *Zizyphus rugosa*, *Desmodium triangulare*, which are covered by various climbers, *Bauhinia vahlii*, *Ampelocissus tomentosa*, *Thunbergia fragrans*, *Cissampelos pareira*, and others, and Orchids like *Cymbidium aloefolium*, *Vanda parviflora*, and others comprise the upper canopy of the vegetation. The lower canopy comprises the various grasses such as *Paspalum scrobiculatum*, *Hackelochloa granularis*, *Cymbopogon nardus*, *Chloris incompleta*, and herbs like *Hibiscus urcatus*, *Indigofera linifolia*, *Desmodium* and *Moghania* species, etc. Similarly, there is not much difference in the vegetation of the region from Rampa to Bolagonda Reserved Forest and from there to Ramavaram through Gunjugudem, Narasapuram, Kota, Annampalem, Pulusumamidi, and Erragondi which comprises trees such as *Terminalia* species, *Dillenia pentagyna*, *Pterospermum heyneanum*, *Chloroxylon swietenia*, *Anogeissus latifolia*, *Garuga pinnata* mixed with huge bushes of *Dendrocalamus strictus* and *Bambusa bambos*, and shrubs like *Grewia hirsuta*, *Woodfordia fruticosa*, *Erythroxylon monogynum*, and *Nyctanthes arbor-tristis*, the last named shrub growing wild covering wide tracts of the hilly slopes. (Transect Fig. 1.)

The various climbers commonly observed are *Celastrus paniculata*, *Ventilago calyculata*, *Cayratia auriculata*, *Cissampelos pareira*, *Argyreia nervosa*, and others. The lower region is covered by various grasses, *Isachne miliacea*, *Paspalidium flavidum*, *Cymbopogon coloratus* (covering large areas on Rampa hill slopes), and other cultivated millet species and herbs such as *Hybanthus suffruticosus*, *Hibiscus vitifolius*, *Canavalia virosa*, *Galactia longifolia*, and others. From some of the humid corners and rocky edges near the streams a few species of ferns, such as *Adiantum caudatum*, *Cheilanthes tenuifolia*, *Pteris pellucida*, *Lygodium pinnatifidum*, *Selaginella barbata*, and a few more, have been collected.

In the Rampa hill country various food grains, such as *Panicum crusgalli* var. *frumentaceum*, the staple food of the hill tribes (Tel. name —shama), *Pennisetum glaucum*, and *Eleusine coracana*, are commonly cultivated at the foot of the hills.

Now coming to further north-east, the hilly region surrounding the villages Ramavaram and Yarlagadda, with a considerable area of cultivated land around, shows typical deciduous forest. The common weeds in the surrounding dry and wet fields with jonna (*Sorghum vulgare*), rice (*Oryza sativa*), and tobacco (*Nicotiana tobaccum*) under cultivation are *Leucas linifolia*, *Caesulia axillaris*, *Eriocaulon quinqueangulare* (near swamp), *Melochia corchorifolia*, *Siegesbeckia orientalis*, *Sphaeranthus indicus*, and *Heteropogon contortus*. Proceeding towards Ethakonda, which was visited twice first in 1920 and again in 1947, on the way to Pasaruginni (1250 ft.) and Chintalapudi (1500 ft.), plants such as *Justicia betonica, Woodfordia fruticosa, Acacia concinna, Argyreia nervosa, Flacourtia jangomas, Aganosma caryophyllata, Hemidesmus indicus, Pupalia atropurpurea, Casearia tomentosa, Andrographis ovata,* and *Phaulopsis dorsiflora* are common. At the base of Ethankonda, a tangled undergrowth with huge lianes of *Acacia, Caesalpinia,* and others intertwining each other, and trees such as *Strychnos potatorum, Pongamia pinnata, Terminalia belerica,* and others. Higher up beyond 2000 ft. *Xylia xylocarpa* is comparatively a more common tree and the vegetation becomes more dense with humid atmosphere, giving a chance for the lichens to grow well. But epiphytic orchids and mosses are not common, though dried up specimens of *Funaria* were observed on tree trunks and in moist corners of rocky boulders. The forest becomes more tangled with a variety of climbers like *Bauhinia vahlii, Mucuna florida, Caesalpinia crista, Dioscorea alata, Asparagus racemosus,* twining among the various trees and shrubs, such as *Xylia xylocarpa, Kydia calycina, Garuga pinnata, Polyalthia cerasoides, Helicteres isora, Murraya koenigii, Mangifera indica, Pterospermum acerifolium, Moghania strobilifera, Colebrookea oppositifolia,* and herbs and grasses, like *Dicliptera roxburghiana* (very common all along the way), *Pimpinella heyneana, Blumea virens, Rubia cordifolia, Apluda varia, Thysanolaena procera, Heteropogon contortus, Oryza meyeriana* (wild paddy), *Cyrtococcum oxyphyllum,* and *Brachiaria kurzii.* Interestingly enough, near the humid, shady corners and along the small hill streams at an altitude of about 2000 ft. to 3000 ft., rare specimens of a few Himalayan plants(*), tree ferns, and other members of Polypodiaceae such as **Drymaria cordata,* **Vitex peduncularis* var. *roxburghiana,* **Linociera malabarica, Cinnamomum zeylanicum, Cyathea spinulosa, Angiopteris erecta, Lygodium flexuosum, Gymnopteris variabilis, Trichomanes bipunctatum,* and several others.

The region on the northern side of Ramavaram and Yarlagadda, extending towards Sesharayi (2000—2500 ft.) and Dumma Konda (4464 ft.) is mostly covered by open deciduous forest with occasional dense humid patches near about ravines and shady corners along the narrow stream, allowing profuse growth of ferns and other plants and giving an appearance of almost semi-evergreen forest of the humid regions. Throughout the deciduous forest of this region, having an altitude of 2000—2500 ft., *Xylia xylocarpa, Anogeissus latifolia,* and *Terminalia tomentosa* form the dominant species of the vegetation with huge bushes of *Dendrocalamus strictus* covering wide areas at certain places near about Sesharayi after crossing Viswanatha Swami Temple on the way. Occasionally pure associations of either *Xylia* or *Anogeissus* have also been observed along the hill slopes on the way. Near about the temple, one of the mountain slopes which is exposed to direct sun for a greater part of the day presents a very dry appearance with *Euphorbia neriifolia* and *Dendrocalamus strictus* growing prominently. *Gnetum ula,* the common robust climber of Gymnosperms, makes its first appearance in this region beyond 2000 ft. altitude. The vegetation in general comprises, apart from the common species above mentioned, huge trees of *Ficus tomentosa, F. mooniana, Garuga pinnata, Mangifera indica,* with climbers such as *Aristolochia roxburghiana, Clematis smilacifolia, Tetrastigma lanceolarium, Smilax macrophylla,* and other plants, such as *Diospyros sylvatica, Pogostemon plectranthoides, Macaranga indica, Grewia tiliifolia,* and many other species. Grasses are few and they are *Panicum brevifolium, Cyrtococcum trigonum, Eragrostis unioloides, Thysanolaena procera, Centotheca lappacea,* etc. Similarly the orchids, which are all epiphytic, are very poorly represented by *Aerides multiflorum, Vanda tessellata, Dendrobium aqueum,* and a few others. (Transect Fig. 2.) Very interesting plants which are recorded for the first time from this area, namely *Spilanthes acmella, Linociera malabarica, Glochidion assamicum, Begonia malabarica, Abelmoschus manihot* var. *pungens,* and other plants such as *Rubia cordifolia, Phyllanthus urinaria, Pleomele terniflora, Cyclophorus adnascens,* and ferns like *Dryopteris urophylla, Pteris pellucida, Hemionitis arifolia,* and others are some of the common species growing along the small hill streams.

Round about Sesharayi and the hill slopes on the way to Gurumanda, the forest is dominated mostly by *Xylia xylocarpa* mixed with *Terminalia* species, *Anogeissus latifolia, Kydia calycina, Adina cordifolia, Sterculia villosa, Tamarindus indica,* and a few others. Climbers like *Bauhinia vahlii* and *Flagellaria indica,* which is the first record of this area, and ferns such as *Lygodium flexuosum, Pteris pellucida, Nephrolepis cordifolia, Dryopteris urophylla* were observed and collected. Of these, a few plants of this area such as *Grewia* species, *Musa rosacea,* huge plants of *Costus speciosus, Dysophylla quadrifolia,* and *Vitex peduncularis* var. *roxburghiana,* a rare medicinal plant recorded for the first time from this area, need special mention.

The vegetation of the area observed while returning from Sesharayi to Yarlagadda via Nulakamaddi and Pasaruginni is almost similar to that of the region mentioned above and mostly consists of the mixed association of *Anogeissus* and *Terminalia* with various plants like *Hibiscus vitifolius, Peperomia dindigulensis, Phyllanthus debilis, Tylophora dalzellii, Jussiea suffruticosa* (a new record), and many others, climbers such as *Zehneria hookeriana, Clematis gouriana,* and others, epiphytic orchids such as *Cymbidium aloifolium, Aerides multiflorum,* and a few others, grasses such as *Oplismenus compositus, Eragrostis unioloides,* and a few more, and ferns such as *Adiantum lunulatum*, *Hemionitis arifolia*, and a few others.

The area between Sesharayi and one of the hill-tops of the Dummakonda Range covering an altitude of 2500 ft.-4000 ft., comprises mostly secondary forest zone along various hill slopes where paddy cultivation was once very prevalent. The most dominant and robust species among the forest trees is *Xylia xylocarpa*, which on certain slopes forms into pure association covering an extensive area. Similarly *Dendrocalamus* species also cover a wide area, forming at certain places into pure association. Members of Podostomaceae growing on the stones in the bed of torrential mountain streams have been collected. The forest all along the way comprises various other trees such as *Emblica officinalis*, *Pterocarpus marsupium*, *Dalbergia odoratissima*, *Terminalia bellerica*, *Chloroxylon swietinia*, *Diospyros tomentosa*, *Gardenia latifolia*, *Casearia tomentosa*, *Glochidion velutinum*, with huge climbers like *Tinospora cordifolia*, *Argyreia nervosa*, *Bauhinia vahlii*, and grasses like *Oplismenus compositus*, a very common undergrowth, *Cyrtococcum oxyphyllum*, *Apluda varia*, and *Thysanolaena procera*, which are very adaptable in covering quickly the open areas of the forest zone. As already mentioned in the earlier pages, the vigorous tree-growth, which is prominent along the slopes, stops at about 4000 ft. and only very few stunted trees with bushy appearance and a few herbs grow along the weathered rocky boulders as a result of which all the hill-tops on this range present a characteristic bald appearance. While climbing to the top, it is felt as though one emerges all of a sudden from a dense forest into an open area from where all the surrounding hill-tops and even the Bay of Bengal are visible. The stunted trees on this hill top are *Phoenix palludosa*, *Emblica officinalis*, *Ptercocarpus marsupium*, and herbs such as *Phyllanthus narayanaswami*, *Osyris arborea*, *Tephrosia roxburghiana*, *Pogostemon plectranthoides*, *Dysophylla myosuroides*, *Vicoa indica*, *Hamiltonia suaveolens*, and the grasses *Apluda varia* and *Thysanolaena procera* are extremely common covering the whole barren top. Strangely enough, epiphytic orchids and ferns are not so common as in the lower ranges.

The track from Yarlagadda to Gurtedu passes along Kakulumamidi River and Yeleru Vagu, covering the valley in between the two hills Ganga-konda (4160 ft.) and Kappa-konda (3539 ft.). Many villages such as Chintakaripalem, Jajigadda, Marakota, and Mattambhimavaram of Gudem Taluk and, crossing the river Pamuleru, other villages like Irlavada, Daragadda, Edlakonda are situated on the way. Most of the forests round about these villages are replaced by the *podu* cultivation and there are many deserted villages (*padu*) on the way where mostly forests of secondary type are gradually developing. The forest of the region after Jajigadda and near about the deserted village of Degalakota is dominated by mostly bamboo bushes of which *Dendrocalamus strictus* is the most common species. Beyond Marakota along the deep valley in between Kappa-konda and Ganga-konda, the place of ups and downs with seven turnings commonly called Edu Vampula Ghat, some of the typical deciduous forests of the area with *Cochlospermum religiosum* as the most common tree have been observed. After Mattambhimavaram, proceeding towards Pamuleru River the dark valley known as Bhusi Gandi with its very humid atmosphere develops a dense original forest with a variety of plants like *Musa rosacea, Caryota urens, Costus speciosus,* and many other species along the stream. A few specimens of *Hydrobryum* have been collected from the bed of the Pamuleru River. The rest of the area up to Gurtedu (1840 ft.) consists of scattered jungles with species *Anogeissus, Terminalia, Lagerstroemia, Woodfordia,* and several others. Some of the common species collected on the way are *Casearia tomentosa, Lagerstroemia parviflora, Gardenia turgida, Eriolaena hookeriana, Machilus macrantha, Schrebera swietenioides, Grewia hirsuta, G. glabra, Nyctanthes arbor-tristis, Abutilon polyandrum, A. indicum, Floscopa scandens, Dioscorea oppositifolia, Teramnus labialis* and also a new record of *Abelmoschus cancellatus.*

The region between Gurtedu (1840 ft.) and Dharakonda (1599 ft.) is covered by some of the best original forests of the area most of which are not under reservation by the Forest Department. The track followed is along the dense valleys watered by the chief tributary of the Gumma Revu stream and the other streams, Manipa Revu and Madimadlu Revu and its tributaries, covering an altitude between 1400 to 2000 ft. Though the area surrounding the various villages on the way is under normal and also *podu* cultivation, most of the original forest appears to be undisturbed. The vegetation comprises the tall trees of *Anogeissus latifolia, Terminalia tomentosa, T. arjuna, Emblica officinalis, Dolichandrone falcata, Schrebera wallichii,* and *Diospyros peregrina,* mixed with shrubby and herbaceous species of *Woodfordia, Grewia, Clerodendrum, Nyctanthes, Wendlandia, Desmodium, Triumfetta, Randia, Flacourtia, Gnaphalium,* and huge climbing species of *Bauhinia, Gnetum,* and *Dioscorea.* Bamboo bushes are very commonly mixed up all along the forest and at certain places along the Madimadlu River, bamboo growth is so dense that it covers the entire area forming the most dominant species among the other tree species of *Terminalia,* and *Anogeissus.* Near about the higher elevations of the valley *Xylia xylocarpa* makes its appearance here and there mixed up with the species of *Anogeissus* and *Terminalia,* the most dominant species of this valley forest (Transect Fig. 3). While crossing Madimadlu River, which was flowing with considerable force with knee-deep water, a few specimens of *Hydrobryum* and other members of Podostomaceae growing on the rocky boulders lying at the bottom of the stream, were collected. The moist banks of the stream are well suited for the profuse growth of *Adiantum* and a few other members of the Polypodiaceae. An epiphytic orchid *Cymbidium aloifolium* growing on a mango tree was also collected. The region at the foot of the hills on either side of the track just before crossing Madimadlu Revu is quite open and though well suited both for dry and wet cultivation, has not been properly cultivated and is desert-like. The open region on either side of the path after crossing Madimadlu Revu covered by tall grasses and scattered bamboo bushes develops, interestingly enough, a large number of small trees of *Nyctanthes arbor-tristis* growing extensively in wild form.

Most of the hill-slopes round about Dharakonda are under *podu* cultivation. Some of the common trees on the neighbouring hill-slopes are *Terminalia tomentosa*, *Anogeissus latifolia*, *Mitragyna parvifolia*, *Xylia xylocarpa*, *Bischofia javanica*, *Kydia calycina*, *Machilus macrantha*, and others, covered with climbers such as *Milletia*, *Acacia*, *Dolichos*, *Bauhinia*, and *Gnetum*. The common herbs are *Trichodesma zeylanicum*, *Crotalaria albida*, *Laggera pterodonta*, *Lepidagathis hyalina*, *Dysophylla myosuroides*, and others. *Nyctanthes arbor-tristis* is also quite common in this area. The wild awnless paddy *Oryza meyeriana* has also been collected. Near the waterfall on the southern side of the village the atmosphere is quite humid and mosses have been observed growing on tree trunks and rocky boulders as distinct green patches.

The track from Dharakonda to Gudem passes through one of the most dense primeval unreserved forests of this area covering an altitude between 1500-3500 ft. The gradual ascent from Dharakonda (1500 ft.) leads to high hill slopes and mountain tops with an altitude ranging between 3000-3500 ft. which continues for a considerably long distance. At certain spots on such altitudes, where there is a network of small streams making the atmosphere highly humid, the vegetation appears to be changing from deciduous to almost semi-evergreen type, producing suitable habitat for the development of very interesting subtropical and temperate species. In this humid and dark valley with an altitude of about 3000 ft. plants such as *Pygeum acuminatum*, *Peperomia reflexa*, *Curculigo recurvata*, *Ophiopogon intermedius*, *Wendlandia gamblei*, *Smilax orolifera*, and ferns such as *Lycopodium cernuum*, *Gleichenia linearis*, *Botrychium daucifolium*, *Blechnum orientale*, *Cheilanthes farinosa*, *Dryopteris cochleata*, *Stenoloma chusanum*, and tree ferns *Cyathea spinulosa*, and *Alsophila glabra*, and many others, all of them typical species of subtropical and temperate regions, have been collected. Due to the favourable humid surroundings, epiphytic orchids are very common in this area. To mention a few, *Dendrobium pierardi*, *Eria bambusifolia*, *Luisia teretifolia*, *Oberonia ensiformis*, *Pholidota imbricata*

DISTRIBUTION OF DOMINANT SPECIES ALONG THE TRANSECTS

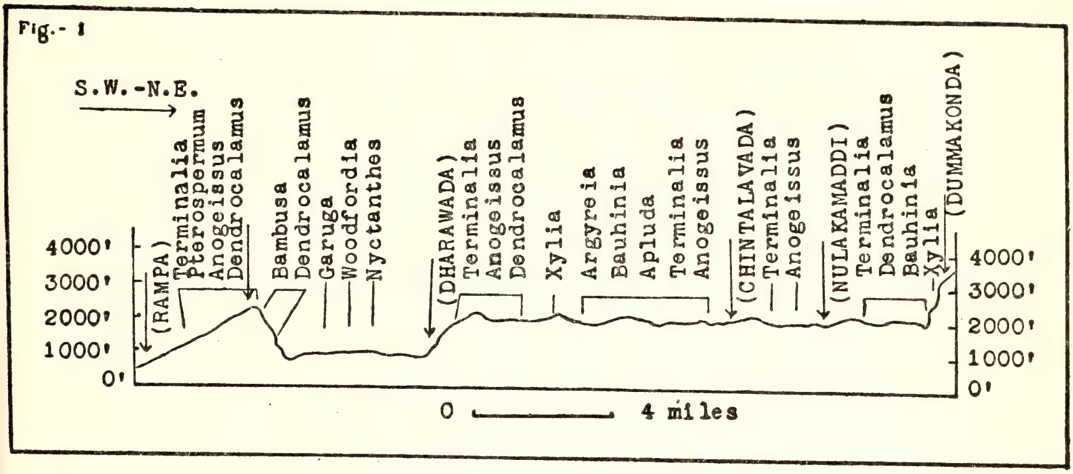
Fig.- 1
S.W.-N.E.
4000'
3000'
2000'
1000'
0'
(RAMPA)
Terminalia
Pterospermum
Anogeissus
Dendrocalamus
Bambusa
Dendrocalamus
Garuga
Woodfordia
Nyctanthes
(DHARAWADA)
Terminalia
Anogeissus
Dendrocalamus
Xylia
Argyreia
Bauhinia
Apluda
Terminalia
Anogeissus
(CHINTALAVADA)
Terminalia
Anogeissus
(NULAKAMADDI)
Terminalia
Dendrocalamus
Bauhinia
Xylia
(DUMMAKONDA)
4000'
3000'
2000'
1000'
0'
0 4 miles

Fig. 1. From Rampa to Dummakonda top.

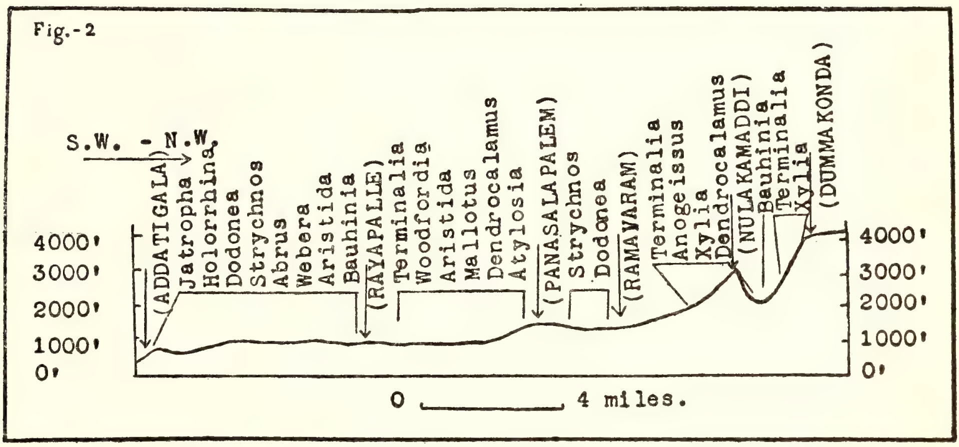
Fig.-2
S.W. - N.W.
4000'
3000'
2000'
1000'
0'
(ADDATIGALA)
Jatropha
Holorrhina
Dodonea
Strychnos
Abrus
Webera
Aristida
Bauhinia
(RAYAPALLE)
Terminalia
Woodfordia
Aristida
Mallotus
Dendrocalamus
Atylosia
(PANASALAPALEM)
Strychnos
Dodonea
(RAMAYARAM)
Terminalia
Anogeissus
Xylia
Dendrocalamus
(NULAKAMADDI)
Bauhinia
Terminalia
Xylia
(DUMMAKONDA)
4000'
3000'
2000'
1000'
0'
0 4 miles.

Fig. 2. From Addatigala to Dummakonda top.

DISTRIBUTION OF DOMINANT SPECIES ALONG THE TRANSECTS

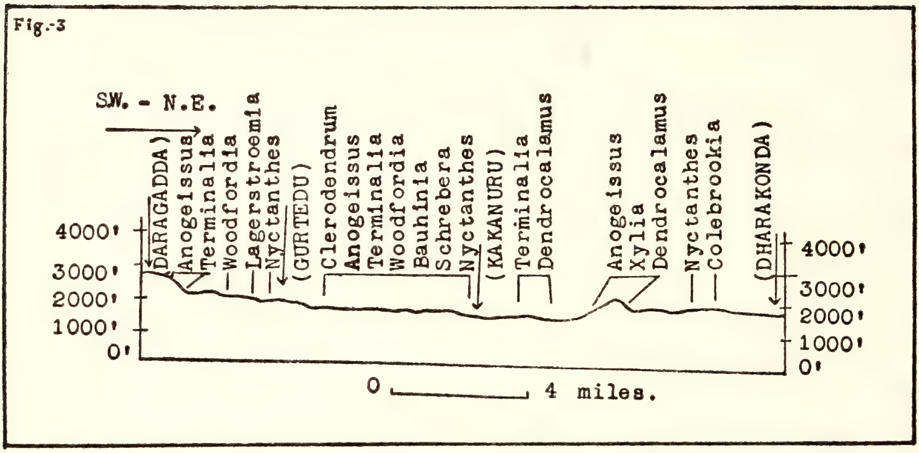
Fig.-3
SW. - N.E.
(DARAGADDA)
Anogeissus
Terminalia
Woodfordia
Lagerstroemia
Nyctanthes
(GURTEDU)
Clerodendrum
Anogeissus
Terminalia
Woodfordia
Bauhinia
Schrebera
Nyctanthes
(KAKANURU)
Terminalia
Dendrocalamus
Anogeissus
Xylia
Dendrocalamus
Nyctanthes
Colebrookia
(DHARAKONDA)
4000'
3000'
2000'
1000'
0'
0
4 miles.

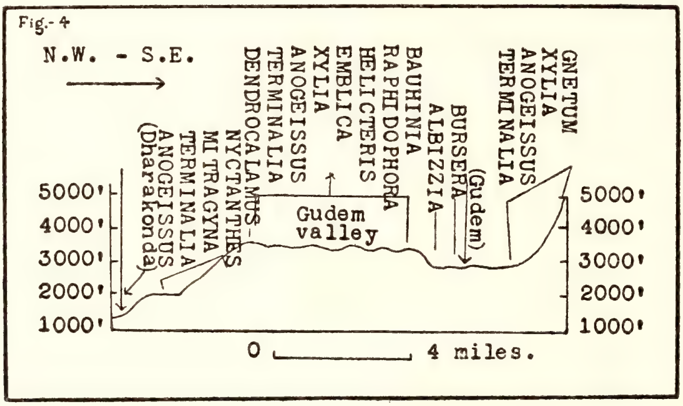
Fig.- 4
N.W. - S.E.
(Dharakonda)
ANOGEISSUS
TERMINALIA
MITRAGYNA
NYCTANTHES
DENDROCALAMUS
TERMINALIA
ANOGEISSUS
XYLIA
EMBLICA
HELICTERIS
RAPHIDOPHORA
BAUHINIA
Gudem valley
ALBIZZIA
BURSERA
(Gudem)
TERMINALIA
ANOGEISSUS
XYLIA
GNETUM
5000'
4000'
3000'
2000'
1000'
0
4 miles.

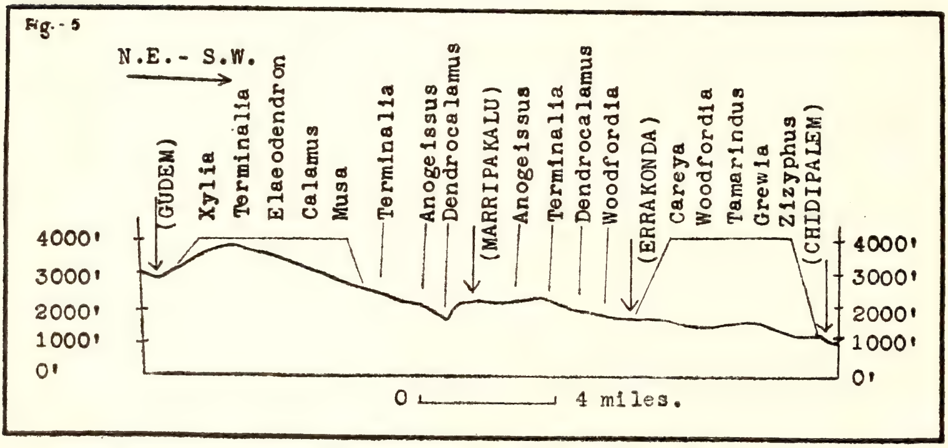
Fig.- 5
N.E.- S.W.
(GUDEM)
Xylia
Terminalia
Elaeodendron
Calamus
Musa
Terminalia
Anogeissus
Dendrocalamus
(MARRIPAKALU)
Anogeissus
Terminalia
Dendrocalamus
Woodfordia
(ERRAKONDA)
Careya
Woodfordia
Tamarindus
Grewia
Zizyphus
(CHIDIPALEM)
4000'
3000'
2000'
1000'
0'
0
4 miles.

Fig. 3. From Datepadu to Dharakonda. Fig. 4. From Dharakonda to Gudem. Fig. 5. From Gudem to Chidipalem.

may be quoted. During the ascent from Dharakonda from 2000-2500 ft., bamboo forest mixed with *Terminalia*, *Anogeissus*, and *Xylia*, and with the undergrowth of *Triumfetta*, *Dicliptera*, *Sida*, *Desmodium*, and *Nyctanthes* is the common sight. On certain slopes *Xylia* is the most common tree mixed up with a dominant growth of *Dendrocalamus* and *Bambusa* species. Shrubby growth of *Zizyphus*, *Helicteres*, *Nyctanthes*, *Flacourtia*, and a tall bushy growth of grasses such as *Apluda*, *Themeda*, *Heteropogon*, and huge leaves of *Bauhinia* climbing over the trees give a dense appearance to the deciduous forests at certain places along the path. On some slopes the bamboo forests are so dense that they may rightly be termed primeval. As there are no villages along this valley, the trees of *Caryota urens* are quite common and undisturbed. Mosses and crustaceous lichens are also common on wet rocky boulders. As the altitude increases to 3000 ft. and above, the density of the forest also increases, presenting a humid atmosphere where the bamboo forest is replaced by the *Xylia-Terminalia-Emblica-Cassia-Anogeissus* association. Gradually, as the deserted village of Saparlu is approached, the forest becomes more dense and dark with high humidity and a network of small streams of Sapar kalava, the main tributary of Madimadlu River, where several interesting plants of subtropical and temperate climates, already mentioned, have been collected. Liverworts and mosses with male and female 'flowers' are very well developed and quite common, covering the moist soil and rocks along the small puddles and streams and also on tree trunks. Ferns and epiphytic orchids are numerous in this area. Climbers like *Raphidophora* and *Smilax* are common. Along the moist banks of streams *Musa rosacea*, *Costus*, tree ferns, *Cyathea*, and *Alsophila* with a height of 15-20 ft., and several other tender herbs have been collected. The valley with such a dense forest, appearing almost of semi-evergreen type, covers a very wide area and, as the altitude falls from 3000–2800 ft. towards the approach of Gudem, the humidity gradually decreases and the narrow path enters into an open dry deciduous forest with exposed mountain slopes. Some of the hill-tops along the way have been observed to be very similar so those of Dummakonda group, presenting a barren, rugged appearance with huge weathered rocky boulders, covered by tall grasses, a few herbs, and stunted trees of *Phoenix*.

Round about Gudem, the country is very picturesque with huge mountain peaks around. Of these, the Sambarikonda with its peak reaching an altitude of 5009 ft. is the highest in the region under study and is also one of the highest peaks in the Eastern Ghats range. The region towards the deserted village of Nilavaram and the Ebul Reserved Forest with an elevation of about 2500 ft. is covered by the common species characteristic of these forests namely *Terminalia* and *Anogeissus* with other trees such as *Albizzia odoratissima*, *A. marginata*, *Eriolaena hookeriana*, *Bursera serrata*, and *Casearia graveolens*, shrubs such as *Gymnosporia bailadillana*, *Grewia tiliifolia*, and *G. abutilifolia*, and the herbs of *Commelina salicifolia*, a few members of *Cyperaceae* near the watery edges, *Alysicarpus*, *Rhynchosia*, *Laggera*, *Leucas*, and others. The common climbers covering the trees are *Zizyphus xylopyra*, *Gnetum ula*, *Thunbergia fragrans*, and *Cryptolepis buchanani*. The orchids particularly species of *Saccolabium* are very common, epiphytic on the forest trees. An interesting terrestrial orchid *Satyrium nepalense* from moist soil and a member of Charales (algae) *Nitella furcata* from the bed of a small tank have also been collected. Several grasses, some of them growing profusely to nearly 6-8 ft., covering the lower regions of the Ebul forest have been collected, e.g. *Cyrtococcum oxyphyllum*, *Apocopsis wightii*, *Themeda triandra*, *T. tremula*, *Cymbopogon martini*, and many others. *Carex stramentitia*, a member of the family Cyperaceae, collected from a few places of this region is the first record for south India.

The hilly region towards south-east Gudem along the route to Sambarikonda with an altitude starting from 2700 ft. is covered with typical deciduous forest with species of *Terminalia*, *Anogeissus*, and *Albizzia*, mixed up with trees such as *Macaranga peltata*, *Litsaea polyantha*, *Embelia tsjariam-cottam*, and others, covered by climbers such as *Aganosma dichotoma*, *Clematis smilacifolia*, *Dioscorea glabra*, and also *Gnetum ula*, which is the most common and robust climber in this region (Transect Fig. 4). Shrubs like *Memecylon gracile*, *Paramignya scandens* (new record for peninsular India), *Grewia glabra*, and others, and herbs such as *Plectranthus*, *Anisomeles*, *Begonia*, *Phrynium*, *Boehmeria*, and many ferns species of *Asplenium*, *Diplazium*, *Leptochilus*, and grasses such as *Microstegium monanthum*, *Apluda*, *Oplismenus*, and several others cover the lower regions of the forest. Interesting collections of *Balanophora indica* with male and female inflorescences, and rhizomes and pinnae from the small trees of *Angiopteris evecta* were made at an altitude of about 4000 ft. The region above 4000 ft. in Sambar Hill (Sambarikonda) could not be explored as the upper part is so steep and rugged that it could not be climbed ordinarily without any special arrangements.

The region from Gudem to Marripakalu along Gangadevi Ghat proceeding down from an altitude of about 3700 ft. to 1500 ft. comprises one of the richest vegetation of the area similar to Gudem valley, unreserved by the Forest Department and undisturbed by the hill people. The track runs along the main tributary of Bodda Revu River flowing down from the Sambar Hill range, and hence the area is watered well by a network of small streams. At certain spots as in the Gudem valley, the forest is so dense with a dark and humid atmosphere that it appears to present a primeval almost semi-evergreen type of vegetation with abundant growth of ferns, including tree ferns such as *Alsophila glabra* and *A. latebrosa,* and orchids, and with profuse undergrowth of shrubs and herbs and closely developed huge tall trees covered by lianes and climbers. Besides the common species of *Xylia, Terminalia,* and others, which form the dominant plants of the forest, the other interesting plants observed and collected are *Elaeodendron glaucum, Glochidion malabaricum, Canthium dicoccum, Pouteria tomentosa, Zizyphus glabra, Pimpinella monoica,* huge bushes of *Calamus viminalis, Musa rosacea,* tufted grasses like *Pennisetum hohenackeri, Setaria palmifolia,* and many others.

Proceeding down from Marripakalu (1324 ft.) to Rayapalle through Errakonda (1086 ft.) and Chidipalem (906 ft.) typical open deciduous forest with the common species of *Anogeissus, Terminalia, Careya, Woodfordia,* and others covering almost plain region with low hills on either side has been observed (Transect Fig. 5).

FREQUENCY OF FAMILIES

Although the collections made in this region are not so exhaustive as to offer any conclusive remarks, a very fair indication of the numerical strength of the most important families can be obtained from an analysis of the collections comprising about 800 species including cryptogams. The eleven families of Angiosperms with a fairly good representation of species are listed below, together with the corresponding sequences of families for the Madras province and for Bihar and Orissa (the surrounding regions of the area under study) as given in Gamble's FLORA OF MADRAS and in Haines's BOTANY OF BIHAR AND ORISSA and also for the whole of India as given in Hooker's SKETCH OF THE FLORA OF BRITISH INDIA for the sake of comparative study :

Sequence for Rampa and Gudem Area.			*Sequence for Madras Province.*	*Sequence for Bihar and Orissa Provinces.*	*Sequence for India.*
	Families	*No. of species.*			
I.	Leguminosae	85	Leguminosae	Leguminosae	Orchidaceae
II.	Gramineae	72	Gramineae	Gramineae	Leguminosae
III.	Euphorbiaceae	38	Rubiaceae	Cyperaceae	Gramineae
IV.	Acanthaceae	30	Acanthaceae	Compositae	Rubiaceae
V.	Compositae	30	Euphorbiaceae	Euphorbiaceae	Euphorbiaceae
VI.	Rubiaceae	26	Orchidaceae	Acanthaceae	Acanthaceae
VII.	Orchidaceae	26	Compositae	Orchidaceae	Compositae
VIII.	Malvaceae	21	Cyperaceae	Rubiaceae	Cyperaceae
IX.	Labiatae	20	Labiatae	Labiatae	Labiatae
X.	Cyperaceae	19	Asclepiadaceae	Scrophulariaceae	Urticaceae
XI.	Urticaceae	19	XIV	..	..

Convolvulaceae (XII) with 17 species, Commelinaceae (XIII) with 14, Scrophulariaceae (XIV) with 13, and Tiliaceae (XV) with 11 follow the above sequence. The number of Dicotyledons is almost three times that of the Monocotyledons, and there is only one species of Gymnosperm. Comparing the sequence of families for the Rampa and Gudem Area and for the Madras Province, the most noticeable changes are the fall of Rubiaceae from third to sixth place, the advance of Euphorbiaceae from fifth to third, and the securing of the eighth place by Malvaceae which has no place at all in the sequences given for the other three regions.

There is quite a good number of plants, which have been collected for the first time from the Rampa and Gudem Agency tracts and which were not recorded by Gamble in FLORA OF MADRAS for these areas. Besides these, there are a few interesting collections given below which are new records: (I) for the Northern Circars, (II) for the Eastern Ghats running along the east coast, (III) for the whole of peninsular India, and (IV) for India.

I. NEW RECORDS FOR THE NORTHERN CIRCARS

Note : Previous records are given after the name of the plant and its family.

1. **Gymnosporia bailadillana** Narayanswamy & Mooney. Celastraceae.
   Bailadila Hill, Bastar & Kalahandi (Mooney).
2. **Galactia longifolia** Bth. Papilionaceae.
   W. Ghats (Gamble) ; Orissa Ghats (Mooney).
3. **Jussiea suffruticosa** Linn. Onagraceae.
   W. Ghats and West Coast (Gamble) ; Orissa (Haines).
4. **Flagellaria indica** Linn. Flagellariaceae.
   Deltaic forests of Mahanadi (Haines).
5. **Curculigo recurvata** Dryand. Hypoxydaceae.
   Forests of Singbhum and Puri (Haines).
6. **Bupleurum mucronatum** Wt. & Arn. Umbelliferae.
   Western Ghats and Nilgiris (Gamble) ; South Kalahandi (Mooney).
7. **Drymaria cordata** Willd. Caryophyllaceae.
   W. Ghats from S. Kanara, Mysore (Gamble) ; Parasnath (Haines) ; Kalahandi, etc. (Mooney).
8. **Abelmoschus cancellatus** Wall. Malvaceae.
   Chota Nagpur, Santal Parganas, Sambalpur (Haines).

II. NEW RECORDS FOR THE EASTERN GHATS

1. **Abelmoschus manihot** var. **pungens** Hochr. Malvaceae.
   Orissa hills (Mooney).

2. **Begonia malabarica** Lam. Begoniaceae.
   Nilgiris, Annamalai, and Pulney hills up to 6000 ft. (Gamble).
3. **Ludwigia prostrata** Roxb. Onagraceae.
   W. Ghats, Annamalais at 2000 ft. in swamps (Gamble); supposed to be in Orissa but not collected (Haines).
4. **Schefflera stellata** Haines. Araliaceae.
   Nilgiris and Pulneys up to 6000 ft. (Gamble).
5. **Balanophora indica** Wall. Balanophoraceae.
   Nilgiris—Travancore hills up to 5000 ft. (Gamble); Mahableshwar and Khandala (Cooke).

III. RECORDS FOR PENINSULAR INDIA

1. **Nervilia crispata** Schltr. Orchidaceae.
   Sikkim. First collected by Pantling in 1895 from Lachung valley (7000 ft.), Sikkim and there is only one sheet in Calcutta Herbarium. Subsequently Narayanaswamy collected it from Devarakonda (2000 ft.) on 7 October 1920.

IV. NEW RECORDS FOR INDIA

1. **Alocasia decipiens** Schott. Araceae.
   Burma and the Andamans. This plant was first collected by Ramaswamy on 8 July 1914 from Rampa hill slopes and was wrongly identified by Fischer as *A. macrorhiza* and recorded as such in the FLORA OF MADRAS.

SUMMARY

The forests of the Rampa and Gudem Agencies located along the Eastern Ghat ranges of Godavari East and Visakhapatnam districts of Andhra State (long. 81° 30′–82° 15′ E. and lat. 17°.15′–18° N.) have been very little explored. The vegetation of this area with an average rainfall of 45–55 inches can be divided into two major zones: (i) the Transitional Zone with a mixture of thorny-scrub and dry deciduous forest types of vegetation (from the 500-foot contour to the 1500-foot contour), and (ii) the Deciduous Forest Zone (from 1500-foot contour upwards). The first zone comprises mostly arid, scattered, thorny, scrub jungle with many xerophytic species. The Deciduous Forest Zone comprises the dry deciduous forest ranging between 1500–3000 ft. (450–910 m.) altitude, and the moist-deciduous forest from 3,000 ft. (910 m.) upwards. *Xylia-Terminalia - Anogeissus - Dendrocalamus* association predominates in various parts of the region under study. Most of the hill-tops of the various ranges present, beyond 4000 ft. (1220 m.) altitude, a characteristic bald appearance with no tree-growth and are covered by dry weathered rocky boulders, allowing stunted

growth of a few shrubs and herbs. The Gudem Valley at an altitude of about 3000-3600 ft. (910-1070 m.) develops one of the most dense primeval, unreserved forests of the area with a few pockets of highly humid, dark corners, presenting almost semi-evergreen type of vegetation where several Himalayan species of *Lycopodium*, *Gleichenia*, *Botrychium*, *Alsophila*, *Peperomia*, *Pygeum*, *Curculigo*, and a few other sub-tropical and temperate species have been collected. The region along the Ganga-Devi Ghat also presents similar primeval forests, with patches of almost semi-evergreen type of vegetation. Occurrence of *Nyctanthes arbor-tristis* and essential oil grass species of *Cymbopogon* in wild condition, covering large tracts of the hill-slopes, is one of the interesting features of the vegetation worth studying in detail. Further, there is great possibility for the development of fruit-growing and other allied industries and also for the exploitation of various other horticultural resources of these Agency tracts.

Several species belonging to such distant regions as the Himalayas, Assam, Burma, and the Andamans have been newly recorded from this area and this indicates the necessity of exploring vast tracts of India for the many unknown species and their newer localities. Various aspects of the region and its vegetation, such as Geology, Climate, Biotic factors, Vegetable resources of the area, types of forests and their floristic composition and frequency of families are given in the paper along with lists of new records collected.

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Some Biometrical Observations on the Common Rats of Bombay

BY

P. J. Deoras and M. S. Gokhale

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The study of rats in relation to plague epidemiology has been made for the last many years[1],[2]. Bombay rats have been studied in the past by the Indian Plague Commission and other workers. Recently, it has been observed in Bombay that the erstwhile carriers of plague, namely *Rattus rattus* and *Rattus norvegicus*, are becoming immune to plague while the Lesser Bandicoot or Indian Mole-Rat *bandicota bengalensis*, normally an inhabitant of fields, is becoming more susceptible to the disease. Some significant changes in the percentages of the different species of Bombay rats collected are also noticeable in recent years.

Considering the present state of affairs an attempt was made in 1954 and 1955 to study the common Bombay rats with special reference to certain biometrical measurements, breeding seasons, and some morphological characters which would help in increasing existing knowledge regarding the general classification of these rodents of Bombay.

A large number of rats (both alive and dead) are received at the Haffkine Institute daily from different parts of the City for examination. From this central pool of rats about a dozen (whenever available) were taken every day for the present investigation. The rats were etherised before measuring. Body measurements were taken with a measuring tape. Rings on the tail and vibrissae were actually counted.

For studying the pads and the rings on the paws the specimens were placed under the binocular microscope. Actual counting of hairs was done for the density of fur in the particular measured area. The number of rats used are given in Table I.

Each form of rat in Bombay has its own characteristic percentage in the rat population. During recent years, a definite shift has been observed in the percentage of the different forms. Table II gives the percentage of different rats brought to this Institute during different years. It will be seen that the percentage of *R. norvegicus* is more or less constant, while that of *R. rattus* shows a definite decrease during

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[1] Hossack, W.C. (1907) : An account of Rats of Calcutta. *Mem. Ind. Mus.* **1** : 1-80.

[2] Reports of Haffkine Institute, 1947 to 1955.

TABLE I:

SHOWING THE NUMBER OF RATS USED FOR BIOMETRICAL OBSERVATIONS DURING THE PERIOD OF STUDY

	No. of rats received at the Institute both alive and dead		No. of rats measured		Sex-wise distribution of the rats used for biometrical observations					
					1954		1955		Total	
	1954	1955	1954	1955	Male	Female	Male	Female	Male	Female
R. rattus	2,31,861	2,40,765	898	931	414	484	471	460	885	944
R. norvegicus	1,67,450	1,80,135	500	617	254	246	228	289	582	535
B. bengalensis	3,56,433	4,51,446	624	736	274	350	423	313	697	663
B. indica	8,139	7,551	18	24	12	6	13	11	25	17
M. musculus	52,568	44,709	13	27	9	4	12	15	21	19
S. murinus	1,22,367	1,04,887	81	98	41	40	52	44	93	84

TABLE II:

SHOWING THE PERCENTAGES OF DIFFERENT RATS RECORDED IN THE RAT CATCHES BROUGHT TO THE INSTITUTE

Year	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
1947	38.0	16.2	34.7	0.2	8.0	2.9
1948	36.6	18.8	31.8	0.4	8.5	3.9
1949	23.3	20.0	42.2	0.4	9.1	5.0
1950	23.9	17.6	39.3	0.7	11.0	7.5
1951	21.1	16.5	36.7	0.8	13.1	11.8
1952	22.6	17.7	38.1	1.0	13.0	7.6
1953	22.3	16.7	39.9	1.0	14.3	5.8
1954	24.7	17.8	38.0	0.9	13.0	5.6
1955	23.4	17.5	43.9	0.7	10.2	4.3

recent years[1]. *Bandicota bengalensis* shows a greater increase as compared with *R. rattus*. This form, originally to be found in fields, is now coming nearer human habitation. The percentage of *B. indica* is very low in the total population. *Mus musculus* and *Suncus murinus* show a slightly increased percentage in recent years.

Table III summarises the observations made on the weight, length of body, length of tail, head, ear, number and characteristics of rings on tail, number of vibrissae, nature of fur on the body, number of mammary glands, structure of paws, droppings, and other characteristics. It is intended to serve the general public as a handy guide for identifying Bombay rats; therefore, details are omitted. Biometrical observations help in giving definite information as regards the measurements of different body parts in the various species. Study of fur is important from the point of host specificity. Ectoparasites, especially fleas, like a fur of thick density and of a texture that will suit their movements on the host's body. *R. rattus*, which carries the largest number of fleas, has fur of thick density and of smooth texture. But the fur is comparatively thin in the case of *R. norvegicus* which carries a smaller number of fleas. Fur of *B. bengalensis* is of harsh texture and thick density; *B. bengalensis* carries more *Xenopsylla astia* than *X. cheopis*.[2] It appears that *X. astia* likes fur of thick density and harsh texture while *X. cheopis*

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[1] Report of Haffkine Institute, 1947 to 1955.

[2] Deoras, P. J. and Tonpi, K. V. (1956): *The Journal of Bombay University* **25** (3): 13.

TABLE III

SOME DIAGNOSTIC CHARACTERS FOR THE IDENTIFICATION OF THE COMMON RATS OF BOMBAY

No.	Character	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
1.	Common name.	House Rat	Brown Rat	Indian Mole-Rat	Bandicoot Rat	House Mouse	Grey Musk Shrew
2.	Habit ..	In and near houses	Away from houses ; in drains	In fields and in open spaces	Only in fields	In houses near man	Insectivorous, near man
3.	Body ..	Medium slender animal	More fleshy than *R. rattus*	Heavy build, piglike face	Very big, ferocious	Looks like a miniature of *R. rattus*	Small, slender, with short snout
4.	Weight*	120–125 gm.	142–146 gm.	234–237 gm.	370–414 gm.	23–26 gm.	60–65 gm.
5.	Total Length	35–38 cm.	35–41 cm.	36–41 cm.	38–45 cm.	15–20 cm.	20–24 cm.
6.	Length of Tail	20–22 cm. Always greater than length of head and body together, uniformly tapering from base to tip.	17–19 cm. Always less than head and body together. Not uniform and tapering. Tuft of hairs at tip.	18–20 cm. Less than or sometimes equal to length of head and body together.	19–23 cm. Equal to length of head and body. Not uniformly tapering.	6–7 cm. Less than length of head and body.	6–8 cm. Less than length of head and body.

* Females are heavier than males.

TABLE III—(*contd.*)

SOME DIAGNOSTIC CHARACTERS FOR THE IDENTIFICATION OF THE COMMON RATS OF BOMBAY

No.	Character	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
7.	Head and snout ..	3.5–4 cm. Short, long and sharp	4–4.2 cm. Wide and sharp	4.5–4.7 cm. Short, stumpy, pig-like	5–5.4 cm. Broad, slightly longish	2–2.3 cm. Small in size	3–3.4 cm. Less broad. Pointed snout
8.	Rings on tail ..	225—240 rings, well marked	165–170 rings, faintly marked	160–170 rings, clearly seen. Scaly tail	230–240 rings, not clear	35–40 rings, not very clear.	No rings. Small, very fine hairs.
9.	Ears ..	2.4–2.5 cm. Translucent. No hairs. Ears reach the eye when stretched forward	2.0–2.2 cm. Opaque and thick. Ears do not reach the eyes	2.5–2.6 cm. Thick and opaque	2.5–2.8 cm. Short and opaque. Ears do not reach the eyes.	1.1–1.3 cm. Small and translucent	0.5 cm. Very small and of a rounded shape like a human ear
10.	Mammary glands ..	5 pairs, 2 pectoral, 3 inguinal	6 pairs, 2 pectoral, 4 inguinal	9 pairs, 2 pectoral, 7 inguinal	10 pairs, 3 pectoral, 7 inguinal	4 pairs, 1 pectoral, 3 inguinal	3 pairs, 0 pectoral, 3 inguinal

11.	Fur ..	Soft blackish brown	Soft, brownish, white on belly	Thick, round, blackish brown, prominent spines present	Very thick, coarse, dark brown, long spines	Fine short hairs, smooth in texture	Smooth grey, faint on belly
	Between fore legs ..	379.8 per sq. cm.	348.2 per sq. cm.	412.5 per sq. cm.	436 per sq. cm.	159.1 per sq. cm.	127.7 per sq.cm.
	Between hind legs ..	343.3 do.	332.6 do.	396.2 do.	420.5 do.	141.2 do.	113.3 do.
	Anterior dorsal ..	388.4 do.	367.6 do.	431.3 do.	443.5 do.	172.7 do.	146.3 do.
	Posterior dorsal ..	366.3 do.	367.6 do.	406.4 do.	415.1 do.	146.3 do.	124.6 do.
12.	No. of pads on forepaws ..	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 4 interdigital, 1 hypothenar, 1 thenar
13.	Shape and average weight of faecal pellets ..	Scattered, sausage-shaped, 0.0521 gm.	In groups, spindle-shaped, 0.0808 gm.	Scattered, oval, 0.0417 gm.	Scattered, big spindles, 0.064 gm.	Fine spindles, 0.0212 gm.	Scattered, small, longish, 0.0258 gm.
14.	Noise ..	*Chew-Chew*	Squeaks	Grunts	*Khur-Khur*	*Chur-chur*	Long note *sheer-sheer*
15.	The month when more pregnant females were received.	June to August	July to August	July to August	—	—	—

TABLE III—(*contd.*)

SOME DIAGNOSTIC CHARACTERS FOR THE IDENTIFICATION OF THE COMMON RATS OF BOMBAY

No.	Character	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
7.	Head and snout ..	3.5–4 cm. Short, long and sharp	4–4.2 cm. Wide and sharp	4.5–4.7 cm. Short, stumpy, pig-like	5–5.4 cm. Broad, slightly longish	2–2.3 cm. Small in size	3–3.4 cm. Less broad. Pointed snout
8.	Rings on tail ..	225—240 rings, well marked	165–170 rings, faintly marked	160–170 rings, clearly seen. Scaly tail	230–240 rings, not clear	35–40 rings, not very clear.	No rings. Small, very fine hairs.
9.	Ears ..	2.4–2.5 cm. Translucent. No hairs. Ears reach the eye when stretched forward	2.0–2.2 cm. Opaque and thick. Ears do not reach the eyes	2.5–2.6 cm. Thick and opaque	2.5–2.8 cm. Short and opaque. Ears do not reach the eyes.	1.1–1.3 cm. Small and translucent	0.5 cm. Very small and of a rounded shape like a human ear
10.	Mammary glands ..	5 pairs, 2 pectoral, 3 inguinal	6 pairs, 2 pectoral, 4 inguinal	9 pairs, 2 pectoral, 7 inguinal	10 pairs, 3 pectoral, 7 inguinal	4 pairs, 1 pectoral, 3 inguinal	3 pairs, 0 pectoral, 3 inguinal
11.	Fur ..	Soft blackish brown	Soft, brownish, white on belly	Thick, round, blackish brown, prominent spines present	Very thick, coarse, dark brown, long spines	Fine short hairs, smooth in texture	Smooth grey, faint on belly
	Between fore legs ..	379.8 per sq. cm.	348.2 per sq. cm.	412.5 per sq. cm.	436 per sq. cm.	159.1 per sq. cm.	127.7 per sq. cm.
	Between hind legs ..	343.3 do.	332.6 do.	396.2 do.	420.5 do.	141.2 do.	113.3 do.
	Anterior dorsal ..	388.4 do.	367.6 do.	431.3 do.	443.5 do.	172.7 do.	146.3 do.
	Posterior dorsal ..	366.3 do.	367.6 do.	406.4 do.	415.1 do.	146.3 do.	124.6 do.
12.	No. of pads on forepaws ..	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 4 interdigital, 1 hypothenar, 1 thenar
13.	Shape and average weight of faecal pellets ..	Scattered, sausage-shaped, 0.0521 gm.	In groups, spindle-shaped, 0.0808 gm.	Scattered, oval, 0.0417 gm.	Scattered, big spindles, 0.064 gm.	Fine spindles, 0.0212 gm.	Scattered, small, longish, 0.0258 gm.
14.	Noise ..	*Chew-Chew*	Squeaks	Grunts	*Khur-Khur*	*Chur-chur*	Long note *sheer-sheer*
15.	The month when more pregnant females were received.	June to August	July to August	July to August	—	—	—

TABLE IV

Frequency distribution of the Vibrissae of the Rats examined

Species	*R. rattus*		*R. norvegicus*		*B. bengalensis*		*B. indica*		*M. musculus*		*S. murinus*	
Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Average of	442	472	241	267	348	331	12	15	10	12	46	42
No. of Vibrissae	48.2 ±6.0	48.0 ±6.1	47.4 ±5.7	47.4 ±6.2	49.3 ±6.3	49.6 ±5.7	49	48.8	26.7	26.3	26.3	26.4

TABLE V

AVERAGE NO. OF EMBRYOS PER LITTER

(Average of 45 rats)

Species	No. of Embryos (Average)	No. of Embryos (Maximum)
R. rattus	6	8
R. norvegicus	6	8
B. bengalensis	8	10
B. indica	10	12
M. musculus	2	4
S. murinus	2	4

prefers fur of thick density and smooth texture such as is found on *R. rattus.* Fleas are seen more in the region between the limbs. It may be that in this region they can conceal themselves more effectively, and or the skin is more suitable for making an incision.

Burrowing habits differ with different rats. *B. bengalensis* and *B. indica* are the most important burrowers. The House Rat, *R. rattus*, if left in an enclosed place, tries all ways and means of escape and, if it fails, then only does it take to burrowing. Field rats, or bandicoots on the other hand, start burrowing as soon as they are let loose. Burrows made by them are generally 'W' shaped. The breeding season varies from place to place, depending upon the climate. Bombay rats breed more during the months July to September. A proper study of the habits of rats tells us when they breed at their maximum during the year, knowledge that helps in drawing up a control programme.

The following are some general observations on the different rats found in the local collections.*

Rattus rattus (Linnaeus) : The House Rat

A very common rodent in Bombay. A clean, neat-living creature. It is a small and slender animal of elegant build. Muzzle sharp ; ears almost naked and translucent and so large as to cover the eyes completely when turned forwards ; tail slender, often considerably longer than the head and body together. Head more long than broad. Fur brownish, paler on the belly ; spines not present in the fur.

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* The nomenclature is according to Ellerman, J. R. and Morrison-Scott, T.C.S. (1951) : CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS 1758 to 1946 Brit. Mus. (Nat. Hist.)

In Bombay this is essentially a house rat. It is so confiding that it may almost be said to be domesticated. It takes up its abode in human dwellings and even breeds in living rooms amongst little disturbed accumulations of rubbish. Although typically a climbing rat, it is also able to burrow. *R. rattus* appears to be more particular in its choice of food than the other forms. The proportion of *R. rattus* trapped increases in grain and seed godowns, and diminishes in non-food godowns.

Rattus norvegicus (Berkenhout) : The Brown or Drain Rat

This rat lacks the elegant build of *Rattus rattus*. It has a longer and sharper snout, small ears, less bristly fur, and a more hairy bi-coloured tail. The tail is shorter than the head and body together. Colour of the fur brownish grey on the back and lighter grey on the belly. Feet large, heavy, and flesh-coloured.

As is well known, this is a rat which lives for the most part outside houses. It is found in Bombay City where drains and sewage exist, but it has also been noticed in houses to a certain extent. It feeds on garbage of any kind. *R. norvegicus* is shy and timid in manner, shunning the society of man but living upon the refuse he leaves. This rat shows a remarkable power of burrowing, gnawing through such hard material as bricks and cement ; it is also a good climber.

Bandicota bengalensis (Gray & Hardwicke) : The Lesser Bandicoot or Indian Mole-Rat

This is the third form which adds to the rat population of Bombay. In the past its occurrence was overlooked owing to its superficial resemblance to *R. norvegicus*. *Bandicota bengalensis* is an animal of heavy build, with a short, stumpy, pig-like face, broad forehead, large ears, rough bristly fur, and a short, comparatively hairless tail. The tail is shorter than the head and body together, having well marked rings.

Bandicota indica (Bechstein) : The Large Bandicoot Rat

Another member of Bombay's rat population, but rather scarce. This rat is a very heavily built and ferocious-looking animal. The muzzle is similar to that of *Rattus norvegicus*, but stouter in size. The tail is shorter or nearly equal to the head and body together. The fur is greyish brown in general, but light grey on the sides. There are long spines on the body which stand out when the animal is enraged.

The damage caused to agriculture godowns due to this rat is considerable. It has big powerful teeth and is a good burrower.

Mus musculus Linnaeus : The House Mouse

The fifth common rat of Bombay, is a small animal looking like a miniature *R. rattus* with a notch on its upper incisors. Its body is clothed with fine fur having a brownish colour. The tail is almost as long as the combined length of head and body. The percentage of this form is not large in the collections, but it is destructive to household material.

Suncus murinus (Linnaeus) : The Grey Musk Shrew

Actually this is a rat-like insectivore, not a rodent at all, found near human habitation. It is an ugly looking, grey, soft-furred creature, with a pointed snout, and tiny eyes. The tail is short and pointed, ears small and of a very peculiar rounded shape rather like human ears. It eats baby rats, mice, frogs, and insects. It is often found inside houses and is never affected by plague.

The Biology of the Weevil *Alcidodes mysticus* Faust (Coleoptera: Curculionidae)[1]

BY

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(*With two plates*)

INTRODUCTION

The weevil *Alcidodes mysticus* Faust was first noticed by the author attacking a variety of cotton known as Sea-island cotton (*Gossypium barbadense*) at Pattambi (south Malabar) early in October 1951. This variety, cultivated on a few islands in the West Indies, is considered to be the world's finest and costliest cotton. It was then newly introduced on the west coast of Madras State by the Madras Agricultural Department for experimental purposes. The occurrence of this weevil was noted immediately after the introduction of this cotton in the locality. It was unrecorded here previously. The grubs of the weevil were found to bore the stem, making the plants stunted in growth and reducing their yield considerably. The flowers dropped off in large numbers during the flowering period as a result of the damage done by this insect. Literature shows no reference to the biology or occurrence of this weevil in a pest form previously in India or elsewhere and this appears to be the first record of such. In view of this circumstance and of the seriousness of the pest on the newly introduced cotton, a detailed study of its biology was made by the author, and the results are presented in this paper.

HISTORY AND SYSTEMATIC POSITION

Alcidodes mysticus Faust belongs to the subfamily Alcidodinae of the family Curculionidae. The species was first described by Faust in 1894 from specimens collected in Burma. Later Heller (1911) gave a short description of the same species. As far as the author is aware, there appears to be no other reference to this species until 1953 when Tirumal Rao mentioned its discovery by the author in a pest form on cotton at Pattambi. The author (1957) has given a short account of its occurrence at Pattambi.

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[1] Part of thesis submitted for the M.Sc. degree of Madras University.

DISTRIBUTION

The weevil has been collected previously from Pusa and Chapra (Bihar) and from Saidapet (Madras) as seen from the labels of specimens in the National Pusa collections. At present its distribution in south India is known to be only south Malabar, where for the first time it has been found as a pest. In his original description Faust mentions the place of collection as Burma.

HOST PLANTS

On the specimens in the National Pusa collections the host mentioned is cotton. At Pattambi the weevil was noted attacking the varieties of cotton known as Sea-island (*Gossypium barbadense*), Cambodia CO2 (*Gossypium hirsutum*), and also the hybrid of these two cottons. A vigorous search was made for alternate hosts of this weevil in the surrounding places near Pattambi. Although it was not found breeding on any other plant, a few adults were collected on *Urena lobata* L., *Urena sinuata* L., and *Malvastrum coromandelianum* G.

NATURE AND SYMPTOMS OF DAMAGE

The adult weevils feed on leaf buds, petioles, and tender terminal portions. They make small pits during the process of feeding and egg-laying on tender shoots. The damage done by the adults is very insignificant. It is the grubs that do serious damage to the crop by boring the stem and petioles. The adult weevils lay eggs in petioles of leaves and at the terminal portions. The grubs that hatch out bore into the petiole and gradually reach the main stem, and from there they bore downwards. At frequent intervals the grubs make exit holes at the sides of the stem and petiole to send out the frass. A large number of grubs bore the stem and feed on the contents, causing a stunted growth of the crop. In the early stages of the crop the attack can be made out by the wilting of tender leaves which in course of time gradually dry and fall off. In an infested field during the earlier stages of the crop a large number of plants with such wilted and drooping leaves can be seen. In a later stage the attack can be easily made out by the presence of small exit holes in the stem and petioles plugged with brownish powdery frass. Attacked plants look stunted and sickly. At the flowering stage, a number of flowers drop off reducing the yield considerably. A single attacked plant may harbour as many as 16 grubs. In one single plant about 27 grubs were collected in November 1952. In severe attack more than 80% of the plants were found infested with the insect. A loss to the extent of 12 to 15% in the yield was noted due to the damage of this weevil at Pattambi.

LIFE HISTORY AND DESCRIPTIONS OF VARIOUS STAGES

There is no literature on the biology and life-history of this weevil. Hence the detailed life-history was studied for the first time in the years 1951 and 1952 by the author.

The entire life-history is completed on the plant itself.

Copulation. The weevil is very rarely seen in copulation in the field. However, they were found freely copulating under laboratory conditions. The copulation in several cases was found to last for 20 to 30 minutes. The time from emergence to copulation varied with individuals and the minimum period was noted to be three days and the maximum six days. Several males were observed to copulate with the same female during the course of the day.

Pre-oviposition period, period of oviposition and fecundity. The pre-oviposition period was found to vary from 8 days to 14 days with an average of 10.4 days for 25 individuals. The weevils were found to lay very few eggs in captivity. The maximum of eggs laid was 38 in the course of 33 days. The daily range was found to be 1 to 3 eggs. The period of oviposition was noted to be very short in the laboratory, the maximum period being only 33 days. The total number of eggs laid varied from 9 to 38 with an average of 20. Under field conditions probably the rate of egg laying may be higher.

Place and method of oviposition. Eggs are usually laid at the tender terminal portions of the plant and under the leaf petioles; sometimes also on the thick veins of big leaves. The weevil makes excavations, the depth of which is as long as the rostrum, and lays eggs in them. In very many cases it was found that three such excavations were made close to each other at a particular place, and that in all cases only the centre one contained the eggs. As a rule only one egg is laid in an excavation, and in no case were two eggs noticed in a single hole. After finishing egg-laying the hole was covered with the material that was scooped out by the weevil. The time taken for laying a single egg was noted, in several cases, to range from 15 to 18 minutes.

EGG

Pale white, chorion smooth, glossy, broadly oval. A freshly laid egg measures on an average 0.99 mm. in length and 0.59 mm. in

ALCIDODES MYSTICUS Fst.

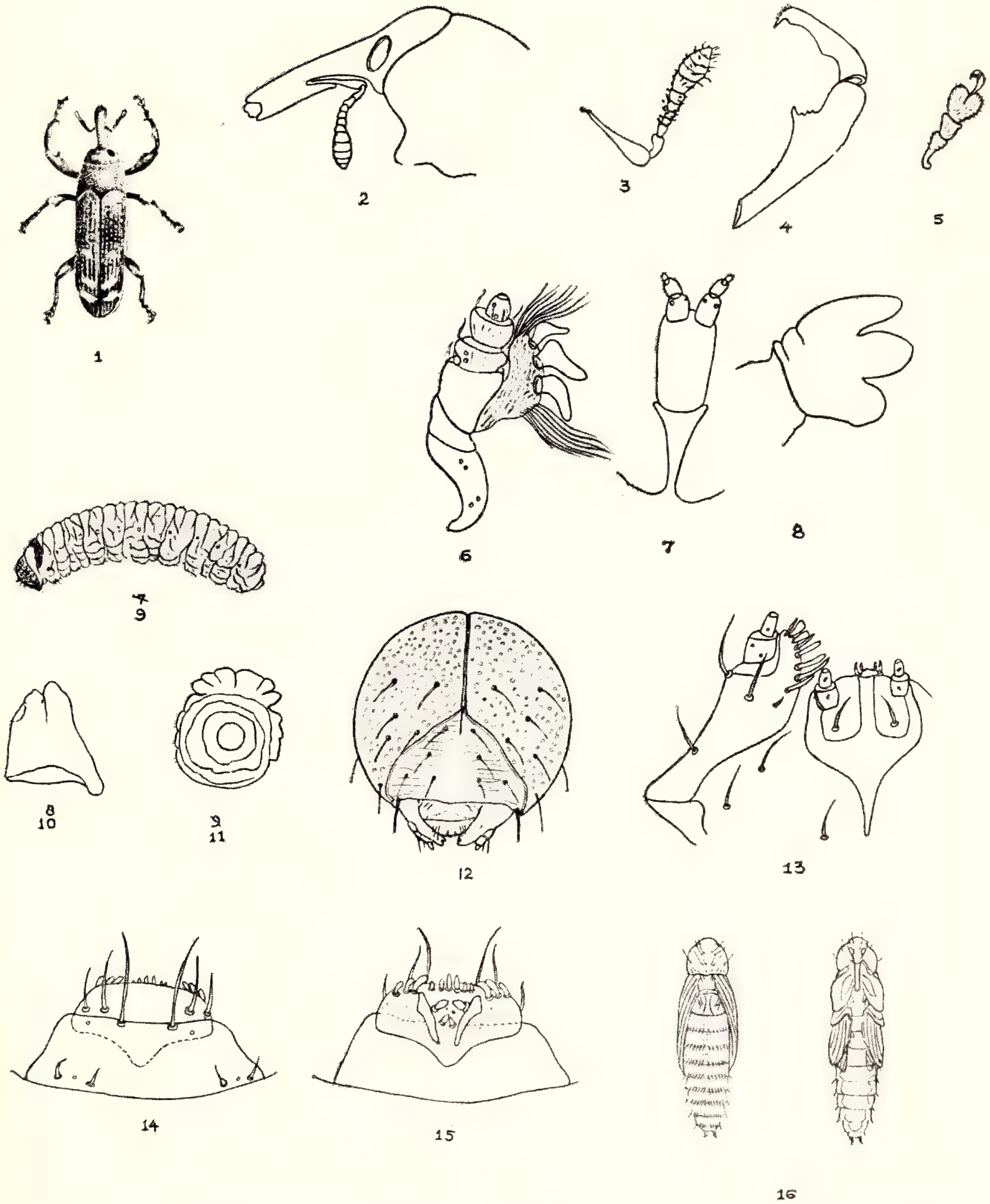

Fig. 1. Adult ; 2. Side view of head ; 3. Antenna ; 4. Front femur and tibia ; 5. Tarsus ; 6. Maxilla (adult) ; 7. Labium (adult) ; 8. Mandible; 9. Grub ; 10. Mandible (grub) ; 11. Spiracle (grub) ; 12. Head capsule (grub) ; 13. Maxilla and Labium (grub) ; 14. Labrum (grub) ; 15. Epipharynx (grub) ; 16. Pupa (dorsal and ventral views).

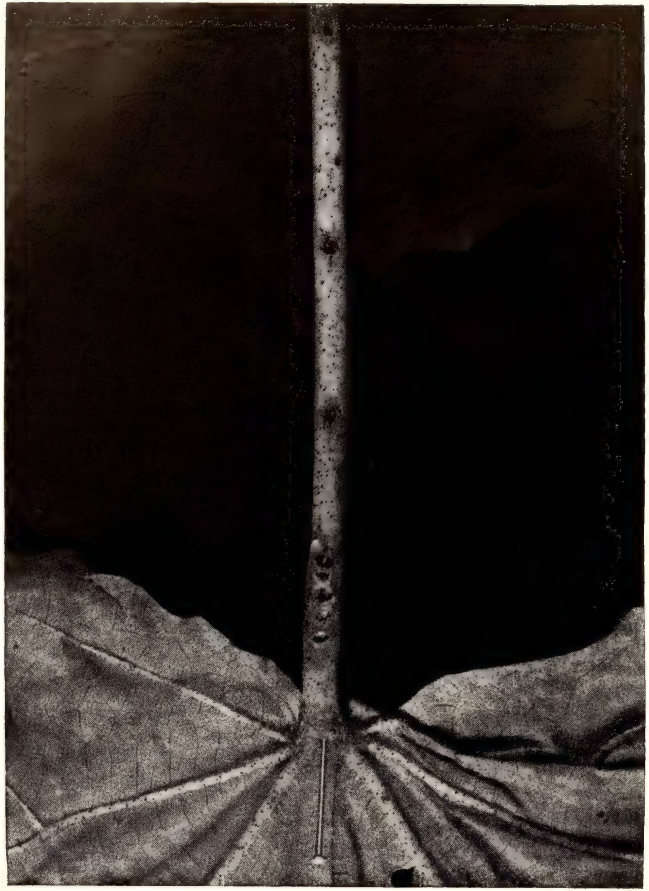

Fig. 1. Leaf petiole of Sea-island cotton showing the weevil attack

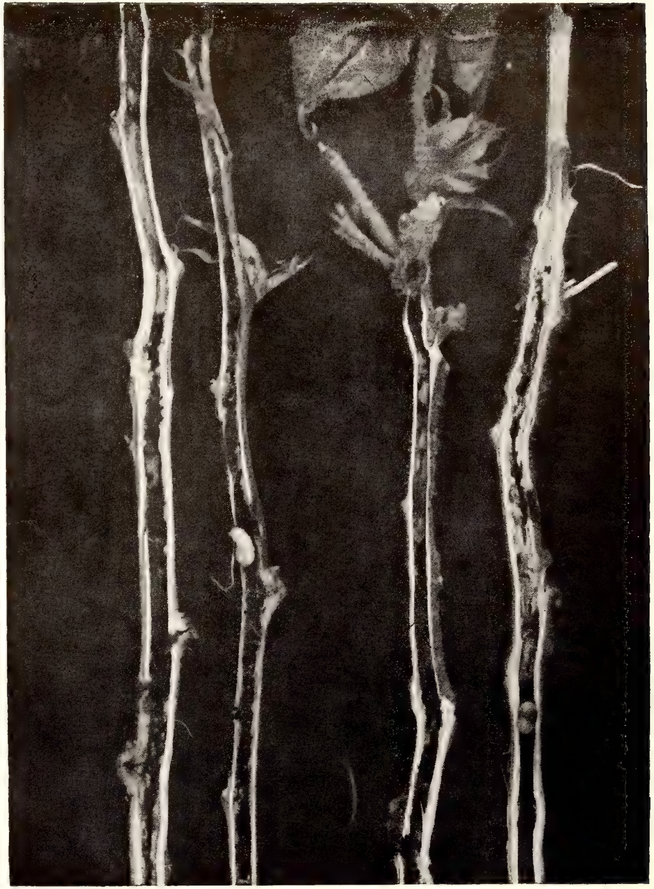

Fig. 2. Infested Stems

width, the length ranging from 0.96 to 1.1 mm. and width from 0.56 to 0.61 mm. Newly laid eggs are white, fragile, while older eggs are harder with brittle chorion. As it develops the egg swells up slightly and the brown mandibles of the embryo become visible after three days. No change in colour is noted until hatching.

Incubation period. Under laboratory conditions when the average maximum and minimum temperatures and humidity were 87.2° F., 78.1° F., and 77.6% respectively, the incubation period of 50 eggs was found to vary from 6 to 7 days, with an average of 6.5 days.

GRUB

The number of the larval instars, the moulting activities, and the duration of each instar were studied in detail. The grub was noted to pass through eight instars in the laboratory. The description and duration of each instar with reference to 25 individuals are given below. There is not much difference in general characters between these instars, except in the measurements of the body and head which vary, and also a slight change in the coloration of the head capsule.

First instar: Length of body 1 to 1.5 mm.; width 0.55 mm.; length of head 0.45 mm.; width 0.45 mm.

Colour pale yellow. *Body* curved and sparsely baset with hairs; slightly broader anteriorly. Apodous. *Head* pale brown, smooth; frons with a small median dark line on the posterior end; mandibles dark brown and prominent and bifid.

The duration of the first instar was found to be six days for all the individuals.

Second instar: Length of body 1.8 to 2.2 mm.; width 0.75 mm.; length of the head 0.58 mm.; width 0.53 mm. Characters similar to previous instar.

The duration of the second instar varied from 6 to 7 days with an average of 6.1 days.

Third instar: Length of body 2.5 to 3.2 mm.; width 0.8 mm.; length of head 0.72 mm.; width 0.63 mm. *Head* light brown, smooth. *Pronotum* pale testaceous. Other characters similar to the previous instar.

The duration of this instar varied from 6 to 7 days with an average of 6.1 days.

Fourth instar: Length of body 3.5 to 4.5 mm.; width 0.8 mm.; length of head 0.84 mm.; width 0.78 mm. *Colour* pale yellow as in previous instars. *Head* deep brown and finely punctate.

Prothorax testaceous brown. Other characters similar to the previous instar.

Fifth instar: Length of body 4.5 to 5.0 mm.; width 1.2 mm.; length of head 1.1 mm.; width 0.92 mm. General characters similar to fourth instar.

The duration of the fourth and fifth instars varied from 6 to 7 days with an average of 6.3 days.

Sixth instar: Length of the body 5.0 to 5.5 mm.; width 2.0 mm.; length of head 1.26 mm.; width 1.15 mm. *Colour* as in previous instars. *Head* dark castaneous and coarsely pitted. The testaceous colour of the prothorax is very distinct.

The duration of this instar varied from 6 to 7 days with an average of 6.4 days.

Seventh instar: Length of body 5.5 to 7.0 mm.; width 2.0 mm.; length of head 1.4 mm.; width 1.34 mm. *Colour* creamy yellow. *Head* dark castaneous, coarsely pitted. The testaceous colour of pronotum very prominent. Other characters similar to previous instars.

The duration of this instar varied from 6 to 8 days with an average of 6.9 days.

Eighth instar: (Full-grown grub).

Length of body 7.5 to 10 mm.; width 2.4 mm.; length of head 2.1 mm.; width 1.50 mm.

Larva apodous. *Colour* creamy yellow. *Body* stout, cylindrical, moderately curved and wrinkled. Head capsule chitinised, dark castaneous, entire mouth frame and mandibles much darker, subcircular, length slightly exceeding width, surface deeply pitted; cheeks broadly rounded. *Epicranial suture* distinct, slightly exceeding half cranial length. *Frontal sutures* distinct, each arm slightly exceeding epicranial suture in length, sinuate; each side of epicranium provided with seven setae. *Frons* sub-triangular with some transverse sculpture on the surface and a dark streak on the posterior end which extends forward to about one-fourth length of frons, one and one-fourth times as broad as long, length equal to epicranial suture; provided with five pairs of setae. *Ocellus* one pair on each side along with a smaller posterior spot. *Antenna* small, two jointed, apical segment conical and longer than wide. *Clypeus* about twice as wide as long with two pairs of setae on the posterior margin. *Labrum* transverse, length about half of width and three-fourths of clypeus, posterior margin prolonged into clypeal zone, upper surface carrying three pairs of setae, the median pair longest. *Epipharynx* with a pair of slender and slightly converging rods which extend into the clypeal zone, the anterior margin with six median setae and three lateral setae on each side; between the rods are two pairs of small setae, the anterior pair much stouter and more widely separated than the posterior pair; in addition a pair of tripartite pores are found between the rods. *Mandibles* strong, subtriangular, bluntly bidentate, shorter than basal width and dark brown in colour. *Maxillae* elongate, terminated by a two jointed palpus and a setose lacinia; *Cardo* smooth; stipes longer than broad with a basal latero-ventral setae and two setae in the palpiferous region; palpus two jointed, basal joint as long as wide and twice as long as the apical joint with a pair of sensory pores. The apical joint is one and a half times longer than wide and provided with one small sensory pore at the base and small sensory pegs at the tip; mala simple, with 9 to 10 long dagger-like setae and another small seta at the posterior end. *Labium* as long as wide, posteriorly limited by a Y-shaped chitinised band and with one pair of long setae on each labial stipe; palpus two jointed each with one small sensory pore, basal joint slightly wider than long, apical one equal in length to the basal joint and one and half times longer than broad and provided with sensory pegs; ligula with two pairs of setae anteriorly; subfascial area entire with three setae on each side.

Thorax. *Prothorax* strongly transverse, dorsally not divided but the two areas prescutal and scutal are roughly indicated by rows of setae; pronotum testaceous brown. *Meso- and meta-thoracic* region divisible into two distinct areas dorsally, namely prescutum and scuto-scutellum; the prescutum provided with two small setae and scuto-scutellum with four setae in a straight line. Pedal lobes prominent and provided with four or five hairs.

Abdomen. Ten-segmented, segments 1 to 8 similar in shape and size with three distinct transverse folds namely prescutum, scutum, and scutellum; a weakly formed inter-segmental fold is also visible. The prescutum is provided with one pair of setae, scutum with one tiny seta, scutellum with four setae in a row; alar area provided with two setae. Each epipleural lobe of abdomen is provided with a single seta and each hypopleural lobe with two setae; the last two abdominal segments simple with a number of setae. *Spiracles* present, one between pro- and meso-thorax and eight in the abdominal segments 1 to 8 on each lateral side, size moderate, circular, air tubes irregular and short and do not project far beyond peritreme, posterior spiracles placed more dorsally.

The duration of the eighth instar varied from 6 to 8 days with an average of 6.9 days.

The total larval period for the 25 individuals varied from 48 days to 52 days with an average of 50.5 days in the laboratory.

Larval habits. Soon after hatching the grub starts feeding on the tissue immediately around the hole in which the egg was laid. Then it starts boring downwards in the case of the main stem, whereas if the egg is laid in petioles, the grub starts boring the petiole and gradually reaches the nodal region from where it travels downwards into the main stem. It makes, at intervals, small exit holes on the petiole and stem as it advances. The distance varies between each hole, usually being shorter at the beginning and gradually increasing as the grub advances in growth. Through these holes it throws out the frass. By nature the grub is very sluggish. Before pupation it prepares a small cavity inside the stem, just bigger than the length of the pupa.

PREPUPA

This stage is characterised by the shortening of the grub in length, and the slight swelling in the thoracic region. The length of this stage is about 8.9 mm., and the period lasts for about 48 hours.

PUPA

Average length of the body 8.9 mm.; width 2.5 mm.

General colour creamy yellow, but turns still darker before its transformation into adult. *Body* soft, beset with moderately long hairs which are concolorous with the body. *Head* as long as broad and provided with five pairs of setae originating from minute tubercle as follows: one pair near the base, two pairs immediately behind the eyes, and two tiny pairs between the eyes. *Rostrum* about one-fourth total length of body and three times as long as its greatest width, pressed against thoracic sterna, bears two pairs of setae in small tubercles, the posterior pair close to the eyes, and the anterior pair between the position where the scape is inserted. *Antennae* geniculate, concolorous with the body, with indistinct segments, inserted in the middle of the snout.

Prothorax occupies one-fifth total length of the body, about one and a half times as wide as long, provided with nine pairs of setae raised on tubercles consisting of two anterior pairs, three median pairs, and four posterior pairs. *Mesothorax* half as long as prothorax; width about twice its length; bears two pairs of setae. *Metathorax* one and a half times as long as broad, and provided with three pairs of small setae.

Abdomen twice longer than broad, nine segmented; segments 1-8 have dorsally a transverse row of six pairs of setae on small tubercles on the posterior margin which consists of two median pairs, four lateral pairs; in addition one pair on the pleural region. The ninth segment is provided with a pair of slender, pointed, curved pleural process.

Pupation takes place inside the larval burrow in the stem. The duration of the pupal stage varied from 9 to 11 days with an average of 10.4 days for 25 individuals.

The total life cycle from egg to adult for this weevil varied from 64 to 70 days with an average of 68.4 days.

ADULT

The original description of the adult by Faust (1894) is as follows:

'Elongatus, subcylindricus niger; fronte rostro parum angustiori, medio foveola abbreviata impressa, antice carinulato rostro subrecto, basi densius fortiterque punctato; prothorace latitudine nonnihil breviore, basi profunde bisinuato, apice subtruncato, lobis ocularibus rotundato-productis, basin versus subparallelo; antice sinuato angustato, supralongitudinaliter convexo, minute granulato; elytris prothorace haud latioribus, fasciis duabus transversis abbreviatis cinereosquamosis, a basi usque ad fasciam secundam striato-fovego latis, interstitiis angustis irregulariter punctatis pectore rugosepunctato hinc inde granulis parvis immixtis. Long 7-10, lat 2-2.6 mm. Bhamo.'

Since Faust's original description is brief, and based on only a very few specimens, the species is redescribed here in greater detail based on a larger number of male and female specimens collected.

Female

Form subcylindrical, integument piceous, not very densely clothed with small pale scales, more or less dusted with rust red powder. *Elytra* with pale markings formed of small short greyish white plumose scales, one small patch just beyond the middle extending from stria 3; another narrow oblique and extending from the suture to the lateral margin just above the apical region and in addition an indefinite preapical band which is broadly interrupted on the suture.

Head closely punctate, a little broader than long; forehead with a shallow median fovea, and with an impressed line round the upper edge of each eye. *Rostrum* elongate, subcylindrical, shorter than front femur, longer and slender, slightly widened at the insertion of the antennae and again at the apex; coarsely punctate at the basal half, but much finner apically. *Mandibles* dark brown, tridentate, as long as broad. *Maxillae* elongated, freely exposed; palpus three segmented, segment 1 twice as broad as long, 2 about twice as broad as long, apical segment half as long as basal segments and as long as broad, small and bluntly conical; palpifer stout, longer than broad, as long, as the first two segments of palpus; stipes as long as first segment of palpus; cardo stout and curved posteriorly, as long as all the three segments of palpus put together; lacinia with prominent bristles and lacinial teeth. *Labium* with three segmented palpi, segment 1 longer than broad, 2 about twice longer than broad, 3 very small, length half of segment 2 and twice longer than broad. *Mentum* stout, twice longer than broad. *Submentum* pedunculate. *Antennae* inserted in the middle; the scape as long as funicle which is 7 jointed, joint 1 as long as 2 plus 3, 3 to 6 bead like and transverse, 7 as long as the first two segments of club; club conical, twice as long as broad, 4 segmented and covered with grey hairs.

Prothorax broader than long, widest at the base, subconical, parallel sided from the base to the middle, roundly narrowed and broadly constricted at the apex; the post ocular lobes rather feeble, the dorsal outline slightly convex, the whole prothorax being tilted upwards anteriorly; dorsum set throughout with separated and much flattened granules except the apical area which is closely and shallowly punctate; *Scutellum* small not enclosed in front, pyriform, broadest behind, bare and with a shallow median impression. *Elytra* cylindrical, not broader at the shoulders than the prothorax, with a broad shallow transverse impression at the base behind scutellum; about three and half times longer than broad, apices separately rounded; striae containing large deep punctures each containing a seta but most of them more or less filled up with scaling or powdering, which are reduced behind the narrow pale band, intervals rather narrower than striae, rugosely punctate with small setiform scales. *Hindwings* about four times as long as broad, hyaline with light brown veins. *Legs* dark piceous with coarse shallow punctures each of which contains a scale; the front femora with an elongated vertical tooth in the middle and three indistinct denticulations in front of it, that on the posterior ones having only one simple tooth; the front tibiae gently curved externally and with an obtuse-angled tooth behind the middle and a sharp prominent tooth at the apex, the posterior ones with a tooth only at the apex, tarsi four segmented, joint 3 bilobed, 4 curved and ends in four small spines; the hind pair of legs distinctly smaller than the other two. *Sternum* with front intercoxal space narrower than median one, the sculpturing of the metasternum concealed by the scaling. *Abdomen* about one and half times longer than broad, surface reticulate and covered with minute hairs.

Measurements (in millimetres): Length of body with rostrum 9.2, width 2.2, rostrum 2.1, antenna 1.8; prothorax 1.9, width 2.2; elytra 5.1, width 1.5; hind wing 6.8, width 1.8; abdomen 2.7, width 1.8 (average of 25 specimens).

Male

The male is similar in general characters to female. Differences are found only in the following: the rostrum of male is short and more stout, and further coarsely punctate throughout; average size of male is shorter than female.

Measurements (in millimetres): Length of body 8.8, width 1.9; rostrum 1.8; antennae 1.5; prothorax 1.6, width 1.9; elytra 3.5, width 1.2; hind wing 5.2, width 1.4; abdomen 2.1, width 1.4 (average of 25).

EMERGENCE

The adults emerge through the holes made by the full-grown grubs on the stem before pupation. As soon as they emerge they are very soft and delicate but get hardened in one or two days.

HABITS

The adults are generally less active. They are often found clinging to the terminal branches, especially at the axils of leaves in the fields. If approached they try to hide beneath the leaves and a slight disturbance makes them fall down and feign death and in this posture they remain for about 20 to 30 minutes. They are rarely seen in the field in copulation. They feed on tender portions of the stem. Though provided with fully developed wings they are not often found to fly from place to place.

LONGEVITY

The length of life of adults of both males and females were studied under laboratory conditions with and without food taking 25 individuals under each sex. The length of life of both the sexes was short under captivity. Unlike in the case of a number of other weevils this weevil was found to die soon under captivity. The duration of life with food varied from 8 to 37 days with an average of 23.2 days in the case of males, and 15 to 38 days with an average of 23.0 days in the case of females. Without food it varied from 4 to 12 days with an average of 6.6 days for females, and 3 to 13 days with an average of 6.3 days for males.

SEX RATIO

The exact sex ratio has not been ascertained but throughout the period of the investigation individuals of both sexes were available in large numbers and males were roughly as numerous as the females.

NATURAL ENEMIES

During the course of this study a few grubs were found to be parasitised by the Braconid *Bracon greeni* Ash. in the field. The parasitism was, however, very low. This was the only parasite noted during the study. Apart from this, the small red ants *Solenopsis* sp. were found to enter through the exit holes on the stem and destroy the grubs in a few plants.

SEASONAL HISTORY

The seasonal history of this weevil was studied at Pattambi. The Sea-island cotton is sown in mid-June at the break of monsoon, and removed by the end of December. Only one generation of the weevil was noted during this period. The egg laying commences by the end of July and continues up to October (maximum in August and September). The adults emerge towards the end of November and in December. The small and medium sized grubs are seen from the middle of August to the end of October, and the full-grown grubs and pupae in November. Most of the adults emerge by the middle of December. The weevils continue to feed as long as the twigs are green but when the crop is pulled out, they enter into hibernation and remain in that condition up to the end of June. They have been found hibernating in all sorts of locations—beneath debris, under bark of trees and on shoots of other wild plants like *Urena lobata* and *Urena sinuata*. Mortality during hibernation is high. Early in July the weevils emerge from hibernation, and start egg laying and feeding during the middle of July on the cotton.

In 1951 the crop was left in the field after picking was over in December as a ratoon crop. In this case a second generation of the weevil was noted from May to August 1952 affecting the ratoon crop. Egg laying was noted in fresh shoots which developed in May after the receipt of summer showers. The second generation adults emerged in the middle of July and early in August, which in turn attacked the newly raised main season crop.

INTENSITY OF ATTACK ON DIFFERENT VARIETIES OF COTTON AT PATTAMBI

Observations were made on the intensity of damage done to four varieties of cotton, namely Sea-island, Cambodia CO2, Hybrid of Sea-island × Cambodia, and Moco, in the year 1952. Under each variety a plot of equal area was marked out in the field and the number of infested and healthy plants were recorded in each month from September to December. The details are furnished in the following table:

Infestation of *Alcidodes mysticus* F. on different varieties of cotton at Pattambi during the year 1952

Name of the variety	No. of plants in the plot	Total number of plants infested during				% Infestation
		Sept.	Oct.	Nov.	Dec.	
1. Sea-island	212	68	94	167	182	85.8
2. Hybrid of CO2 and Sea-island	216	63	87	142	160	74.1
3. Cambodia CO2	232	31	52	98	134	57.7
4. Moco	178	—	8	24	32	18.0

It was found that the infestation was more on Sea-island and the hybrid Sea-island × CO2 cottons the percentage of attack being 85.8 and 74.1 respectively. The next variety that showed high infestation was Cambodia CO2, the percentage being 57.7. Moco showed the least incidence the percentage being only 18.0. This indicates that Sea-island cotton is more susceptible to the attack of this weevil than other varieties.

SUMMARY

The weevil *Alcidodes mysticus* Faust is recorded for the first time as a pest in India. It attacks a variety of cotton known as Sea-island cotton at Pattambi (south Malabar) where the crop has been recently introduced by the Madras Agricultural Department. The grubs of the weevil bore the stem of the plant with the result the crop becomes stunted in growth and the yield is also considerably affected.

The detailed life history and various aspects of its biology were studied. The weevil lays eggs in excavations made on terminal shoots and leaf petioles. Eggs are laid in 8 to 13 days after emergence. The period of different stages of the weevil are found to be 6 to 7 days for egg, 48 to 52 days for larva, and 9 to 11 days for pupa. The duration of adult life in captivity varies from 8 to 37 days for males and from 15 to 38 days for females. This weevil has a very poor egg laying capacity in captivity, the maximum eggs laid being only 38. The period of oviposition is also very short being only 33 days. The grubs have the peculiar habit of making exit holes at the sides of the stem to throw out the frass.

The weevil attacks apart from Sea-island cotton, other varieties of cotton also, namely Cambodia CO2, and hybrid Sea-island ×

Cambodia CO2, though Sea-island is the more susceptible. Adults have been collected on other plants like *Urena lobata, Urena sinuata,* and *Malvastrum coromandelianum.*

The grubs are parasitised by a Braconid *Bracon greeni* Ash, the parasitism being very low in fields. The seasonal history has been fully described; there is only one generation in the crop of Sea-island cotton at Pattambi.

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Catla Fishing in Powai Lake, Greater Bombay

BY

F. R. GOLDSCHMIDT

(*With five text figures*)

To anglers, who would like to specialise in Catla fishing, I am giving my views for what they are worth. They are based on personal experience over 12 years, but restricted to Powai. The reader will soon find that the subject on which I am elaborating is quite controversial. But it is the object of these lines to interest others in trying out new and better methods in circumventing the Catla.

The fry of catla were first introduced into Powai Lake along with rohu, mrighil, and calboos in 1937. Today there are many more of these fine fish in the Lake than is commonly believed. When the water is calm like a millpond one can watch them rising. A pair of binoculars is useful. They can be identified easily by their dark grey-green back breaking the surface like a porpoise, and splashing the water with their colossal tail rudder as they dive.

It is said that catla never take the baited hook and that all of them are foul-hooked. This is not true because I have landed them with one or both hooks in the mouth. This, to be sure, happens rarely. Usually he is foul-hooked either outside the lips, under the 'chin', or in the fins or tail. Because of such foul-hooking 9 out of 10 fish are lost at Powai. Most disappointing indeed; but it leads to one conclusion: our method of catla fishing is wrong. Either the type of bait is not attractive enough or the tackle is wrong, or both. I shall revert to this later.

Let me however at this stage say that, contrary to general opinion, I consider this fish is a very cunning, moody, and unpredictable customer. There is very little information available in piscatorial literature on its ecology and feeding habits, from which the angler could draw conclusions.

It is mentioned [Chacko and Kuriyan (1950): The Bionomics of the Carp *Catla catla* (Cuv. and Val.) in the South Indian Waters, *Proc. Zool. Soc. London* **120**: 38-42] that catla is mainly a surface and mid-water feeder; that his food consists of vegetable matter and plankton.

Examination of the stomach contents also revealed presence of crustacea. Reference is also made in their paper to Mookerjee, H. K. (1945): Life-Histories of some major Carps of Bengal (*Sc. and Cult.* **10**: 400-402) reporting that 'crustaceans formed the major portion of its diet, but sometimes, though rarely, it browses along the marginal substances and feeds on molluscan shell'. Chacko and Kuriyan further report that catla swims with its mouth wide open, straining the water through the gill opening and retaining micro-plankton in its buccal cavity.

I think catla is a pure vegetarian and feeds mainly on the algae suspended in the water, or on the 'moss' which grows on submerged rocks. He is built for this, the disproportionately large mouth with the lower lip protruding like a spoon.

Catlas have quite a different diet as compared with our other game fish at Powai, i.e. rohu, mrighil, and calboos. This is borne out by the fact that the weight of catla has increased year by year, while the other major carp have not grown satisfactorily during the last eight years no doubt due to lack of food. I have observed a catla grazing on moss from the rocks and the body was at an angle of about 45 degrees. The sloping position probably assists in scraping the moss off the rocks with the lower jaw working like a dredger bucket.

The catla does not or cannot pick up the baited hook from the bottom without difficulty because of the structure of his mouth. This difficulty increases if the bottom is not completely clean. Stones will prevent him from getting at the bait with his bulky lips. He therefore has to suck in the bait along with the water. The conclusion to be drawn is that the bait, in addition to being acceptable, should be as small and light as possible to be easily sucked up with the inhaled water. He may succeed on occasions, but usually he does not because the bait is too heavy. He will then leave the bait or try to shift it by pressing against the line with his head or body.

The question arises: Why then should the bait rest on the bottom? Why can it not be suspended an inch or more higher? I have tried this and fixed one hook 3 inches above the other and arranged it as shown in fig. 1. I have hooked—and lost—catla this way but the only fish I brought to gaff in this manner was caught on the *lower* hook. There it is! It may have been by chance, but I have not entirely given up fishing this way. I would also say: in years past, when I fished mainly for rohu and mrighil, I used a single small hook (Mustad No. 4) on 8 lb. Monofil. Nylon, never any lead. Whenever I hooked a catla that way, I am quite sure that he was hooked in the mouth because I played him for a long time and did

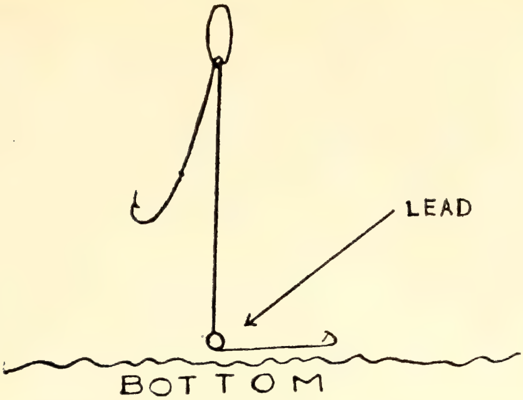


Fig. 1. Second hook suspended about 3 inches above the first which is shown lying on bottom.

not lose him because of foul-hooking. I lost him nevertheless. Either the small hook opened out or the leader broke after some time. So, there is food for thought!

Now let us go to the practical side and try to explain failure or success in the light of what I have theorised above. I have hooked catla in most parts of the Lake, though I have never had a bite in the 'Pipe Line Bay' and to my knowledge only one catla of 12 lb. was ever caught there. I have had bites at all times of the year: in December, January and September in the Lobo Bay, from February up to the beginning of July between the Dams (old raft sites) and in the Clubhouse Bay and below the Powai Club, and during and after the rains in Brighton Beach and Everglades.

The most suitable depth is 5-7 feet, but I hooked a catla in January 1958 in Brighton Beach in less than 3 feet of water and this was a good fish of over 50 lb., which broke around a tree after 55 minutes. The most important factor in my selecting a site has always been to fish over a clean bottom, free of large stones; a little slope is an additional advantage.

Now to the tackle: I have already warned my readers that I do not consider the tackle which others and myself are using at the Lake as the ideal outfit. In any case, some of my gear is correct. The first item is a stiff rod of about 8 feet, a reel with adjustable brake (Windex are unbeatable) and at least 350 yards line.

A home-made peacock float (bazar floats are clumsy and useless) is of course a MUST. But now the trouble starts: lead or no lead? Fishing without lead is a great advantage. Not only is the bite more pronounced, but the bait can be taken by the fish more readily. The problem however is how to get the bait down without a lead before it is eaten up by Chilwa and Olive Carp. And there is more trouble to come: single hook or two hooks? And the trace? Mugga silk or monofil? My answer to this is: unless I learn of something better (most certainly there is) I shall be using two medium size long-shank hooks (Kantu No. 17 or 18). The testing of hooks with pliers is essential. The hooks may be mounted on mugga silk and arranged (as in fig. 2) to keep the baited hooks apart: Fishing should be with a slightly sloping line. If the depth is say 5 feet fix the float 6 feet high and cock it by taking up line.

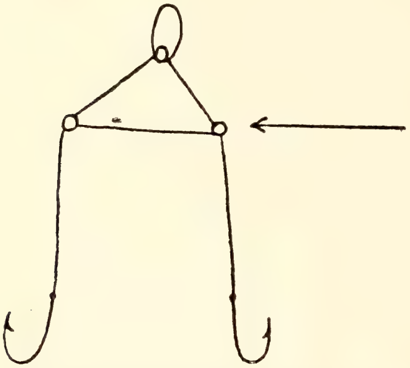


Fig. 2. Two hooks mounted on Mugga silk and arranged as in figure to keep the baited hooks apart. The arrow points to the copper wire of about 1 mm. thickness.

And now we are coming to the all important point of ground-baiting. As I have attracted catla regularly to my swim I think my groundbait is good. It has been changed, experimented with and improved upon over the years, and now consists of three types, all of them being used together:

(*a*) MUD BALLS: Two parts earth (mutti); one part mustard oil cake (fried in Dalda) powdered; one part boiled rice; a pinch of hingh (asafoetida) and huldi (turmeric); $\frac{1}{8}$ part of roasted and powdered methi seed. Mix with a little water into a dough. Then add a little ghee and form into balls of about golf ball size. If the mixture is correct it smells like Italian Salami Sausage.

(*b*) SWEET MEAT: One part boiled rice; one part mustard oil cake, as above, $\frac{1}{4}$ part ghee. Knead and make balls of walnut size. Ten balls should last for eight hours fishing.

(*c*) PEBBLES: Collect a dozen small porous lava stones from the lake-side. Soak them in ghee and keep them in the sun for some time, so that the ghee can properly penetrate into the stone. (The idea is that the Olive Carp cannot eat stones though, otherwise, they consume anything.) This completes the ground bait.

The preparation of hookbait is simpler: fresh white breadloaf is kneaded into a dough together with a little ghee. It is then kept in a glass jar for three to four days when it develops a sweetish smell. Just *before* commencing fishing mix with a little boiled rice. I add a little dry bread, ata, or milkpowder, if the paste has become too soft. If it has become dry a little ghee should be added. That's all. This of course is not the catla's natural food, but I have still to come across a better bait. I have mentioned already that the bait should be light and small. It is quite sufficient if the lower part of the hook is covered. Lumps of walnut size are absurd! Fig. 3 will illustrate the required actual size.

And now, at last, we commence fishing: The boat is tied securely so that I am not bothered with the poles again after an hour. Get the correct depth and put the unbaited hooks at the place where you intend groundbaiting. An unbaited pair of hooks is good for investigating the bottom for stones and other obstacles. If the place is clean, commence groundbaiting and throw in a couple of 'mudballs'. Only a few to begin with. If Olive Carp are there in strength they will clear the place in 15 minutes even if you throw in a whole bucketful. Groundbaiting therefore has to be continued by throwing in 2 to 3 balls every half an hour till the carp biting stops. In addition the place has also to be baited with 'pebbles' as they cannot be consumed and therefore keep the ghee scent for some time. In between a ball of 'sweetmeat' is thrown in. As soon as the Olive Carp are gone I throw in 4 to 5 'sweetmeat' balls.

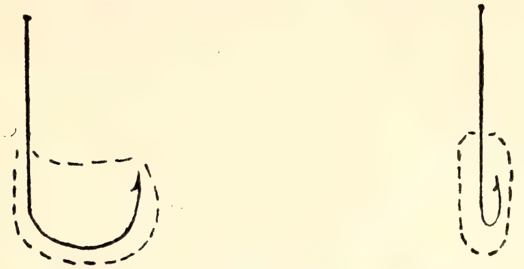


Fig. 3. Actual size of ideal bait and the hook for catla.

One has to sit it out till Olive Carp and other small fish leave. If my paste is not touched any more, I keep the rod in my hands all the time. The bite of a catla lasts only a second or two. By the time you snatch your rod and strike it's all over! It happens occasionally that one has a catla bite between carps. But as a rule the sudden disappearance of carp is a sure indication that there is something 'fishy' about. One has to be ready for a strike then though it may only be a rohu who has driven off the small fish.

Quite often the catla gives his presence away. He may be rolling in front of you; the Chilwa may jump to all sides; he may be making a swirl below the water causing a circular movement; or he may let off that famous huge 'bubble'. All these signs are warnings to be on guard. But there is no guarantee that a bite will follow 'in due course'. Anyhow, once he is around you, the first thing is dead quietness. I have on many occasion observed that anglers strike at the slightest movement of the float, even if it is a clear carp bite. I consider this definitely wrong if there is a real customer around. The strike produces a noise and movement which may scare away the fish you are after. I strike only if I am reasonably sure that it is not a carp, even at the risk of not striking if a catla imitates a carp (which also happens).

To identify a catla bite is quite easy in calm water. But it is not always recognizable in choppy water, unless the float is pulled. But then it is usually too late.

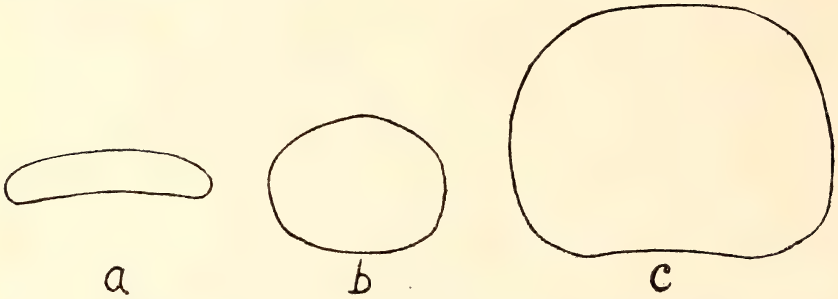


Fig. 4. *a*, *b*, and *c*. Outline drawings of the gape of mouth of mrighil, rohu, and catla respectively.

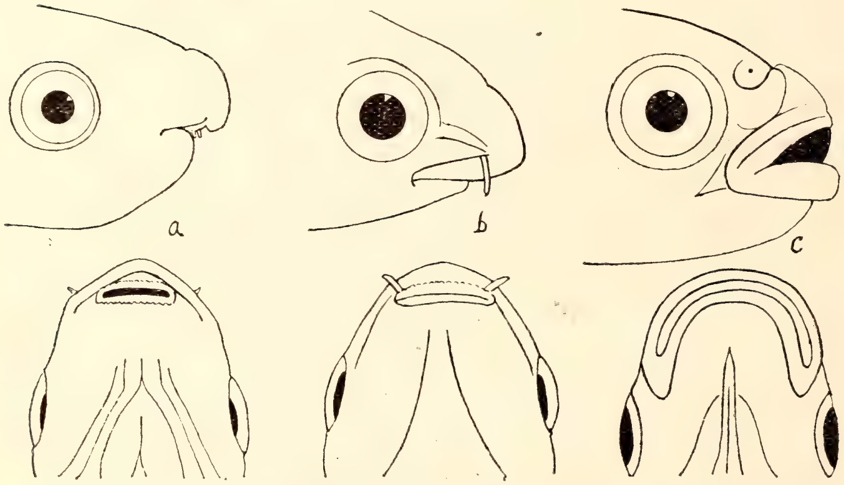


Fig. 5. Outline drawings of the anterior part of the head (lateral and ventral views) of: (*a*) rohu; (*b*) mrighil; (*c*) catla, showing the position and nature of the mouth opening.

There are five typical catla bites:

(*a*) float, without perceptible warning, is slowly going down. This is the most common bite and the chances are you hook him foul and he is off immediately or after his first run.

(*b*) float makes one or two slow bobs. I strike to the first bob if I am quick enough.

(*c*) float moves from the tilting into the perpendicular position or vice versa, several times. This is the best bite. Strike immediately.

(*d*) float begins to quiver. It is a sort of trembling, not to be mistaken with the bobbing of a rohu, which is much more pronounced and slower. When you observe this quiver, don't wait for further development but strike.

(*e*) float is taken down in stages. It starts with a slight depression. After a few seconds there is a further depression by perhaps an inch. You feel the next pull will take the float under water. I do not strike to that. I have done it many times but did not connect. But when the depressed float, without further pull, moves like a crab-bite a few inches to one side, you must strike.

These are the 'standard' bites. Strike always with a resolute kick with both hands and *not* with a half-hearted long pull. Never mind if it was a crab or catfish which fooled you. There are several other variations in a catla bite, such as raising the float like a rohu, or jerking it like a carp. But such bites are rare and quite exceptional.

As already mentioned, to observe a bite in windy water is very difficult. Without fear of contradiction I would say that in disturbed water most catla bites are never noticed.

If you hook a catla you usually know immediately what you are in to. For a second you feel you have hooked a wooden log or gunny bag. But then there will be water swirl and off he moves gaining speed. It is just the opposite of a rohu run. Rohu goes off in top gear, slows down and comes to the surface or he jumps. The catla moves of in first gear before he goes into top gear. He will always keep to the bottom unless he is forced to the surface.

Playing a well-hooked catla is grand sport and to land him I follow this golden rule: he will tire himself out as long as he *runs*. He will make a first long run of 100 to 200 yards, often more. Reel in with pressure on the line the moment the run is over or follow up in a boat. He will make his second and third run. Now comes the critical point: The moment he refuses to run again, sulks on the bottom, jerks the line by hitting it with his tail, or 'walks' slowly along, you have to force him to the surface at the risk of breaking him. He cannot run at full speed for more than fifteen minutes without losing his breath. But he can 'walk' for ten hours and will go on doing that once he has got his second wind! The finest fish in Powai Lake have been lost by not observing this rule. (On one occasion I played a fish from 9.45 a.m. till 3 p.m. and finally lost him). Once the fish is on the surface, one has to keep him there under full pressure on the line. One has to move the boat to where he is on the surface or bring him alongside the raft or boat. But he must not be allowed again to 'walk' along on the bottom. The main point of course is that he is properly hooked. If not, you will lose him anyhow.

Once on the surface, he puts up little fight. One can easily gaff or net him. The safest way is to put the gaff into his mouth and hook him through the lower jaw. A landing net will do as well if big enough to take the head and part of the body. He does not splash about or turn when seeing the net as a rohu does.

Looks quite simple and will work alright but for the three big IFs: as I have just said, he must be securely hooked; secondly, there should be no trees, sunken logs, or other obstacles around, where he is sure to go in order to break the line; and thirdly, the tackle must be all sound. A breaking strength of 15 lb. for line or trace is quite sufficient and it is anyhow more than a normal rod can stand. A 15 lb. pull can force to the surface a fish which has lost his wind after a couple of fast, big runs. But anglers seem to believe that a line or trace remain sound and intact for an indefinite period. This is not so. Mugga silk traces in particular should not be used more than once or twice. They lose most of their strength if they have been in the water for a day and break then easily at the knot. Monofil has a tendency of getting damaged upon severe stress. One can detect the minute transverse cracks in the structure with a magnifying glass. Such cracks, which look like a thin white ring around the the line, reduce the breaking strength by about 50%. By the way a foolproof knot for monofil has still to be invented. The best to my knowledge is the sailors' sling knot. One has to test the gear regularly, at least the first 30 to 40 yards of the line complete with trace and hooks. The weakest part of your outfit is usually the rod. Hence if you lift a played out catla of 50 lb. and over to the surface and the line snaps but the rod remains intact, your line was damaged and had a strength of less than 15 lb.

And now I wish my reader to hook and successfully land one of the granddaddy catla of 100 lb. and over of which there are quite a few at Powai. Tight Lines!

New Plant Records for Bombay—V

BY

H. SANTAPAU, S.J., F.N.I., R. R. FERNANDES, M.SC., AND
Z. KAPADIA, B.SC.

(*With five plates*)

(*Continued from Vol.* **53**: 216)

In the course of our intensive studies on the flora of Bombay, we have come across several plants that, though not new to science, have never previously been recorded for Bombay State. We present several of our new finds here in this series, with the hope that the descriptions and illustrations will be of help to other Bombay botanists.

Family ALISMATACEAE

Alisma oligococcum F. Muell. Frag. Phyt. Austr. **1**: 23, 1859; Hook. f. Fl. Brit. Ind. **6**: 560, 1895.

A water plant, growing in fairly shallow water, the roots attached to the ground, the leaves and inflorescence above the water surface. *Leave*s simple, radical, petiolate, up to 13 in number; petiole up to 30 cm. long, trigonous; lamina 15-20×7-15 cm., at first submerged, then floating, acute, entire, in the lower leaves elliptic, in the higher ones ovate-oblong, base cordate, the sides overlapping; main nerves about 7, convergent. *Inflorescence* paniculate, pyramidal, much branched, 20×30 cm., branched in whorls of three, becoming shorter upwards, bracteate; the whole scape up to 60 cm. long, erect, strongly ribbed; bracts linear-lanceolate to ovate, acute or acuminate, clearly parallel-veined, green, 1-8×0.4-0.8 cm., becoming smaller upwards. *Flowers* white, 8 mm. diam., hermaphrodite, pedicellate, bracteolate, in whorls of three; pedicels up to 4 cm. long. *Sepals* orbicular-ovate, green, hooded, persistent, marked with 6 brown lines, 3 mm. long. *Petals* obovate, deciduous, 5×4 mm. *Stamens* 6, free; filaments as long as the petals; anthers dark. Ovary 6-carpellary, carpels green, ovoid, 1-ovulate; style slightly lateral, shorter than the ovary; stigma indistinct. Fruit an etaerio of achenes, which are more or less reniform, muriculate, 4 mm. long; embryo horseshoe shaped. (Plate I).

Flowers and Fruits: September-October.

Occurrence in Bombay: We have only seen this plant in the National Park, Borivli, near Bombay; it is still a rare plant in the district. (*Fernandes* 1566-1572).

Family SCROPHULARIACEAE

Lindernia multiflora (Roxb.) Mukerjee in *J. Indian Bot. Soc.* **24**: 131, 1945.

Torenia multiflora Roxb. Fl. Ind. **3**: 96, 1832.

Vandellia multiflora G. Don, Gen. Syst. **4**: 549, 1838; Hook. f. Fl. Brit. Ind. **4**: 280, 1884.

Annual, erect *herb*, 8-15 cm. high, glabrous, profusely and regularly branching from near the base. *Leaves* simple, opposite and decussate, glabrous; the lower ones larger, ovate, obovate, or oblanceolate, tapering into a short petiole; higher leaves broadly ovate, sessile or nearly so, the margins of all the leaves crenate or serrate; larger leaves 2.5-4.5×1.2-1.7 cm., the smaller ones 1.2-2×1-1.3 cm. *Inflorescence* racemose, often corymb-like, terminal, occasionally branched. *Flowers* small, bracteate, pedicellate, bluish purple in colour; bracts minute, triangular, persistent, herbaceous; pedicels slender, 5 mm. long, enlarging to twice this length in fruit. *Calyx* green, 2 mm. long enlarging to 3-4 mm. in fruit, divided almost to the base into 5 subequal, linear acute lobes. *Corolla* 4 mm. long, 2-lipped to a little below the middle; upper lip short and narrow, shallowly divided at the apex into two lobes; lower lip 3-lobed. *Stamens* 4, all fertile, didynamous, included; anther cells somewhat divaricate. *Ovary* ovoid, glabrous; style 2 mm. long; stigmas 2. *Capsule* glabrous, green, ovoid, apiculate, slightly exserted beyond the calyx. *Seeds* minute, yellow, oblong or cylindrical, sparsely granulate. (Plate II).

Flowers and Fruits: Monsoon period until October.

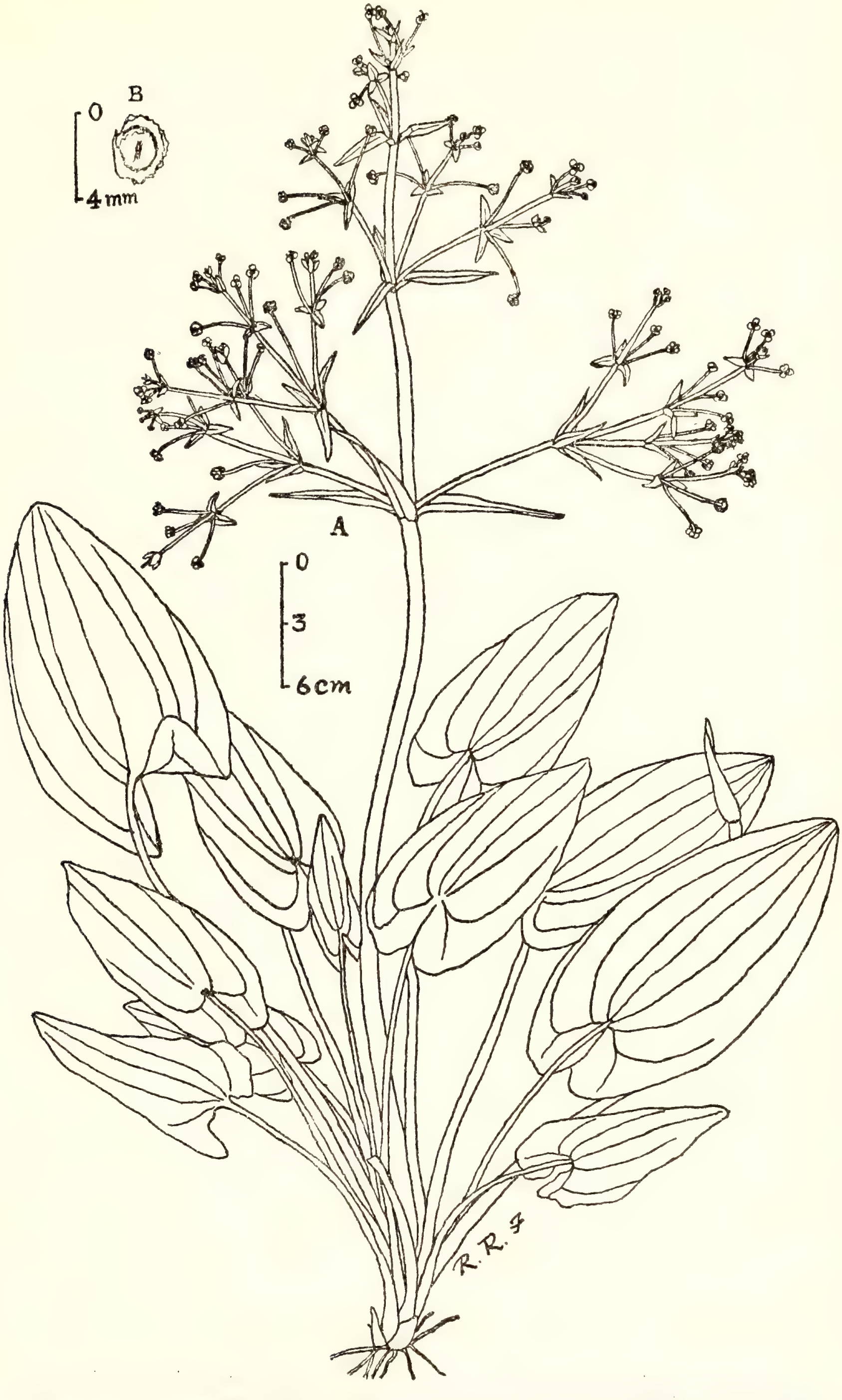
Occurrence in Bombay State: We have found this plant as a weed in Victoria Gardens, Bombay (*Saldanha* 1301); also at Waghai in the Dangs Forest, along forest paths, where it was abundant (*Santapau* 19988; *Saldanha* 1930).

Family ORCHIDACEAE

Oberonia iridifolia Lindl. var. **denticulata** Hook. f. in Fl. Brit. Ind. **5**: 675, 1885; Fischer in Gamble, Fl. Madr. 1404, 1928.

Oberonia denticulata Wight, Icon. t. 1625, 1851.

This species seems to be widely distributed in India, from Sikkim and Bhootan to Assam and southwards to the Nilgiris; so far neither the typical species nor its varieties have been reported from Bombay. The present variety differs from the typical plant, as illustrated and described by King & Pantling (in *Ann. Roy. Bot. Gard. Calcutta*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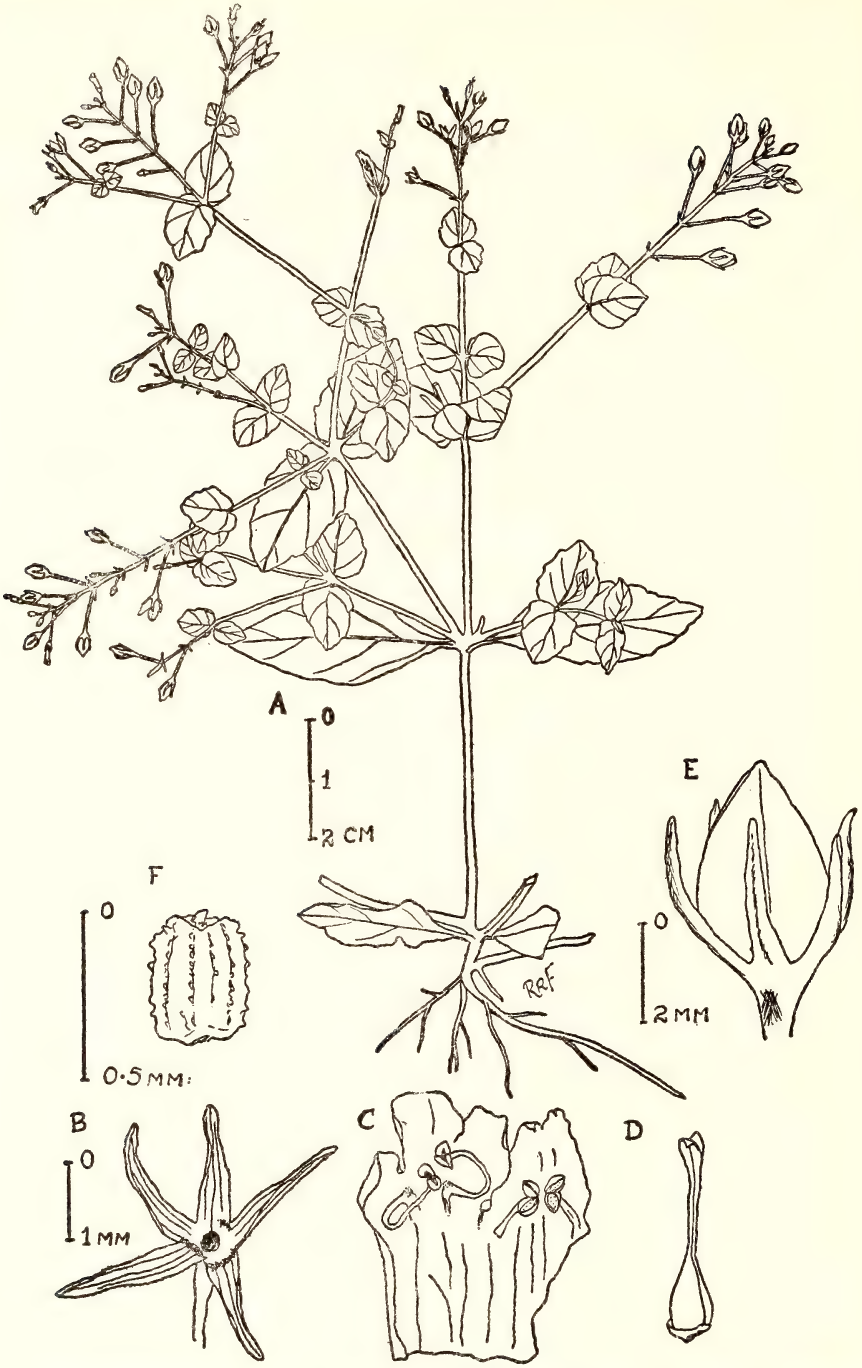
Alisma oligococcum F. Muell. A. Whole plant to show the habit; B. Achene.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Lindernia multiflora (Roxb.) A. Whole plant showing habit; B. Calyx; C. Corolla; D. Pistil; E. Capsule; F. Seed.

8: 8, 1898) in the following particulars: (*a*) The scape is bracteate; (*b*) The lip is much less deeply lobed; (*c*) The lip is more triangular-quadrate in appearence, not orbicular. The detailed description of our plant follows.

Perennial, epiphytic, erect or pendulous *herbs*; roots small, slender, clustered at the base of the plant and spreading outwards. *Stem* small. *Leaves* distichous, sessile, fleshy and broadly ensiform; lamina oblong-lanceolate, acute or acuminate, entire, glabrous, laterally compressed, 4-14×1.5-2.5 cm. *Inflorescence scape* 7-24 cm. long, decurved, arising from the centre of the uppermost leaves and longer than them. Pedicels very short or 0, the flowers densely crowded towards the upper part of the scape; bracts on the lower part of scape few; floral bracts up to 2×1 mm., slightly reflexed at the apex, ovate or oblong to elliptic, subacute, irregularly crenate or toothed, longer than the subsessile ovary. *Sepals* subequal, broadly ovate to suborbicular, subacute or obtuse and even sometimes slightly retuse, one-nerved. *Petals* 1×0.6 mm. ovate-oblong, obtuse, occasionally somewhat retuse, margins irregularly toothed, one-nerved. *Lip* 1.5×2 mm., broader than long, triangular to quadrate in outline, more or less deeply 3-lobed; lateral lobes pectinately erose; terminal lobe entire or 2-lobulate with a broad sinus, the lobules denticulate or entire; nerves of the lip 3, the central one straight or nearly so, the lateral sinuous. *Column* very small, 0.25×0.5 mm., but stout for its size. *Anther* opercular, greenishwhite, transversely oblong-orbicular; pollinia 4, broadly comma-shaped, brownish yellow. *Capsule* 5×2 mm., shortly stalked, broadly ovoid. (Plate III).

Flowers: September. *Fruits*: October onwards.

Occurrence in Bombay: We have found this plant epiphytic on *Tectona grandis* Linn. f. in the neighbourhood of Tansa Lake (*Santapau* 16030; *Kapadia* 1638, 1711); we have also found it on the banks of the Kali Nadi in North Kanara at Gundh, about 45 km. from Dandeli.

Habenaria furcifera Lindl. Gen. Sp. Orch. 319, 1835; Hook. f. Fl. Brit. Ind. **6**: 149, 1890; King & Pantling in *Ann. R. Bot. Gard. Calcutta* **8**: 313, t. 410, 1898; Haines, Bot. Bih. Or. 1157, 1922; Duthie, Fl. U. Gang. Pl. **3**: 225, 1925.

This Orchid is of widespread occurrence in the northern and north-eastern parts of the country; but until recently it had not been found in peninsular India south of Orissa. This is the first record for Bombay State.

A ground orchid perennating through one or more underground tubers, which are ovate or ellipsoid, up to 3×1.5 cm. *Stem* stout, up to 40-46 cm. high, glabrous, with several sheaths below the leaves. *Leaves* 13-17×3-6 cm., clustered together below the middle, gradually passing into bracts above, sessile or subsessile and somewhat narrowed at the base, glabrous, broadly ovate or obovate or oblanceolate or elliptical, entire at the margins or minutely denticulate, acute at the apex. *Inflorescence* stout, lax, racemose, many-flowered, 25-40 cm. long; scape bracteate, glabrous, occasionally longitudinally ribbed; lower bracts 6-7×3-6 cm., ovate-lanceolate, acute, gradually becoming smaller upwards. *Flowers* small, green, subsessile; bracts 1.3×0.3 cm., ovate-lanceolate, acuminate, about as long as the ovary, margins entire or minutely denticulate. *Sepals* unequal; the dorsal one 4.5×3 mm., concave, ovate oblong, obtuse, entire; the lateral sepals narrower, oblong-lanceolate, 3-nerved, somewhat falcate, subacute to acute, gland-dotted. *Petals* 4×2.5 mm., broadly oblong, obtuse or slightly retuse and forming a hood over the column with the dorsal sepal. *Lip* 6×6 mm., trilobed to the base; lateral lobes filiform, divergent, much longer than the stout blunt mid-lobe. Spur slightly longer than the ovary, laterally compressed and involute at the base. *Anther* cells 2, touching, rather short, caudicles slightly curved; glands small and narrowly oblong. *Staminodes* 2, elliptic, blunt, stalked, one on each side of the entrance to the spur. *Rostellum* a thickened, horny rim just above the orifice, from the centre of which a small, ligulate projection is given out, which forms a flap over the mouth of the spur. *Capsule* 1.5-0.55 cm., fusiform, turgid, decurved, with strong, broad ribs; beak of capsule short, about ¼ as long as the body of the capsule. (Plate IV).

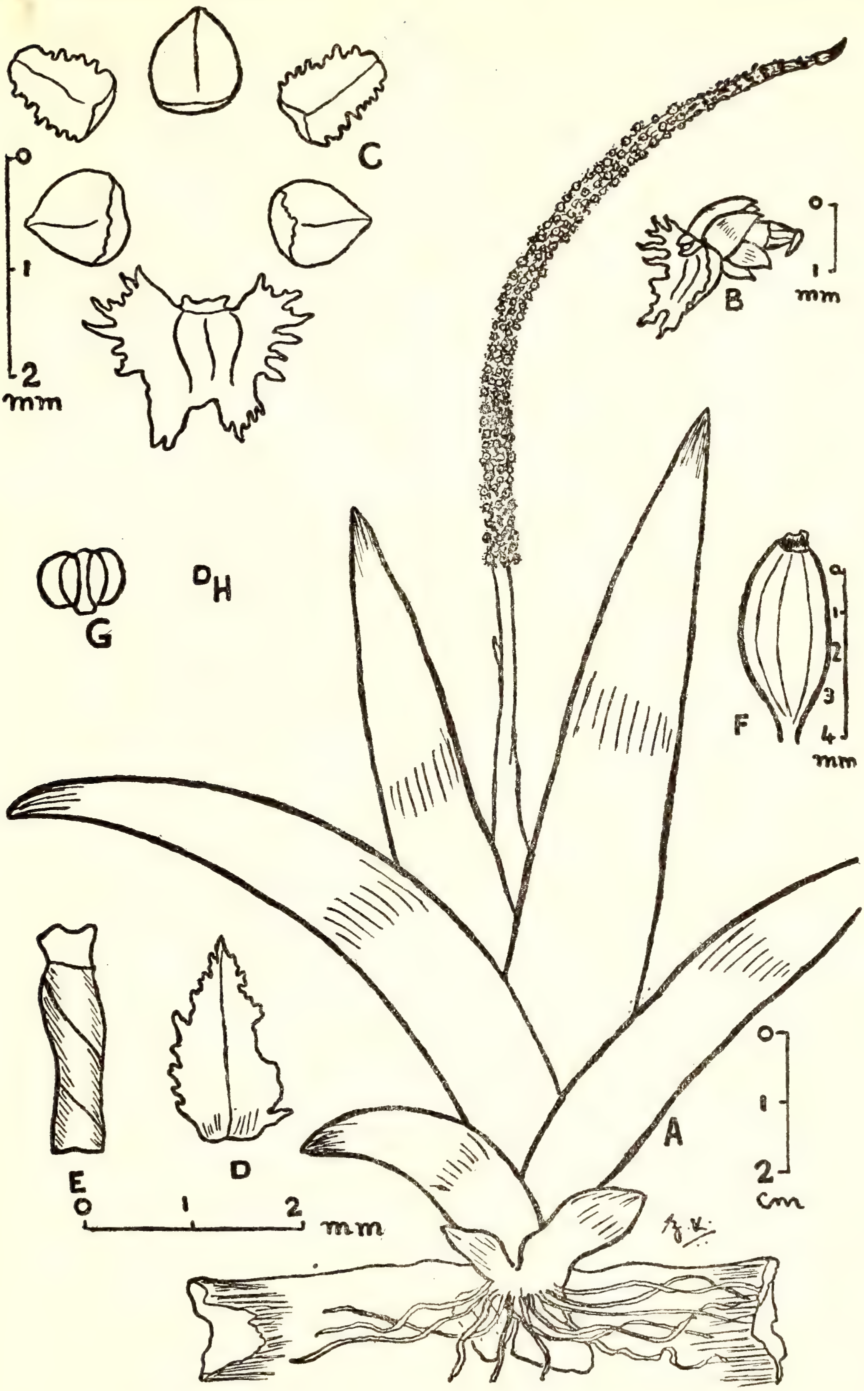
Flowers: August and September. *Fruits*: October.

Occurrence in Bombay: We have found this plant to be common in the undergrowth at Waghai and Ahwa in the Dangs Forest (*Santapau* 19204, 19143, 19343; *Kapadia* 681, 1438).

Dendrobium peguanum Linn. in *J. Linn. Soc.* **3**: 19, 1853.

D. pygmaeum Lindl. in Wall. Cat. no. 1999, 1829, nom. nud. et Gen. Sp. Orch. 25; King & Pantling, loc. cit. 43, t. 58, 1898; Kranzl. in Pfreich. 45: 83, t. 3 L-O, 1910; Hook. f. Fl. Brit. Ind. **5**: 717, 1890 (non Smith ex Rees, 1808).

Perennial, epiphytic *herbs*. *Pseudobulbs* 1-7×0.9-2 cm., pear-shaped, ovoid or subglobular, sheathed, generally one- or two-, occasionally three-noded. *Leaves* 2-4, caducous, rarely persistent, fleshy, coriaceous, alternate and distichous, 1.5-6×0.8-2 cm., sheathing at the base, sessile, linear-oblong or oblong, subacute or obtuse, entire; midnerve depressed above, prominent below, with 4-6 faint lateral nerves. *Racemes* 1-13-flowered, apical or subapical, up to 5 cm. long; peduncle short, terete, 1-1.5 mm. in diam., purplish green with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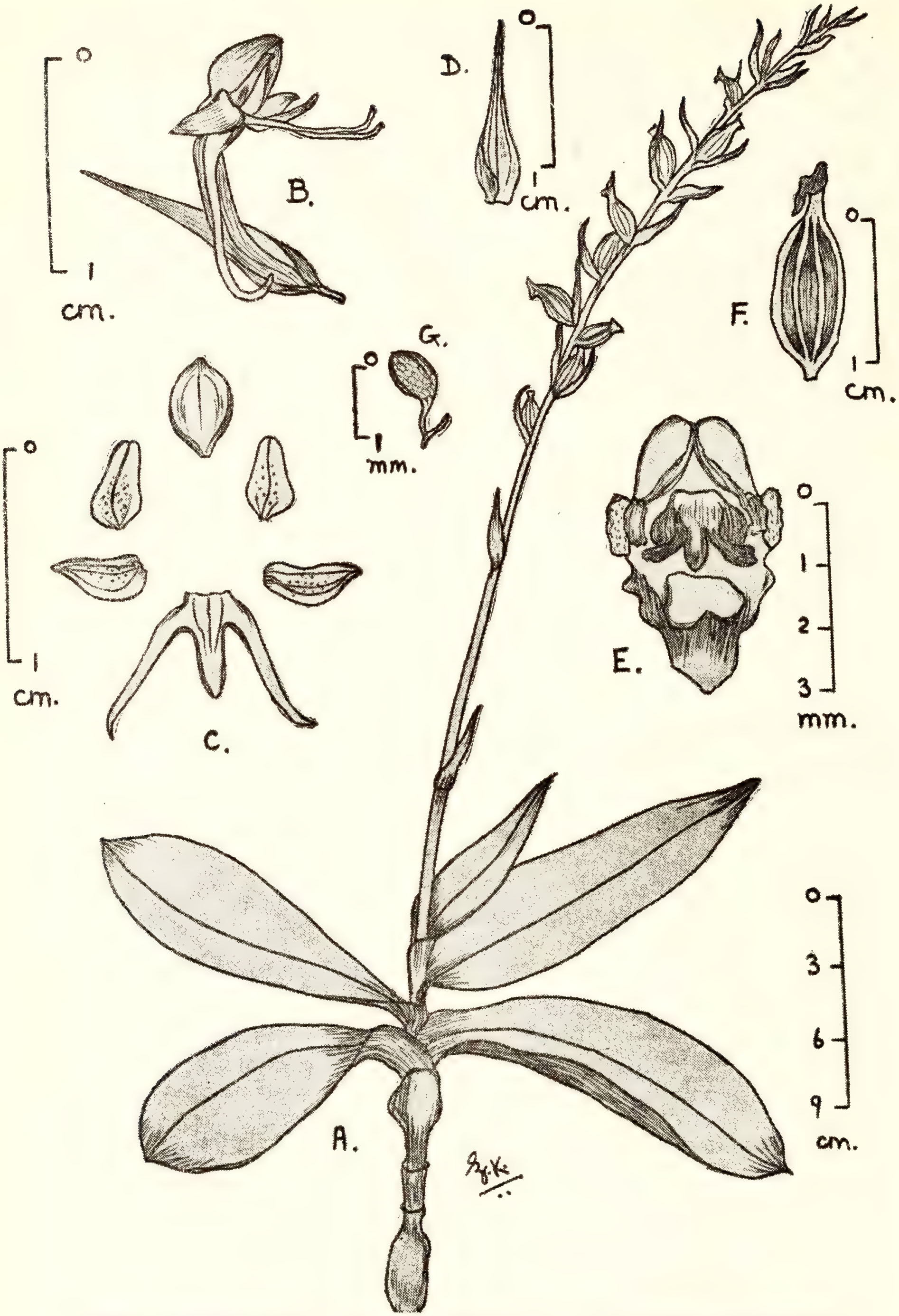
Oberonia iridifolia Lindl. A. Entire plant; B. Lateral view of flower; C. Calyx and corolla dissected; D. Floral bract; E. Ovary and column; F. Fruit; G. Anther; H. Pollinia (G and H highly magnified).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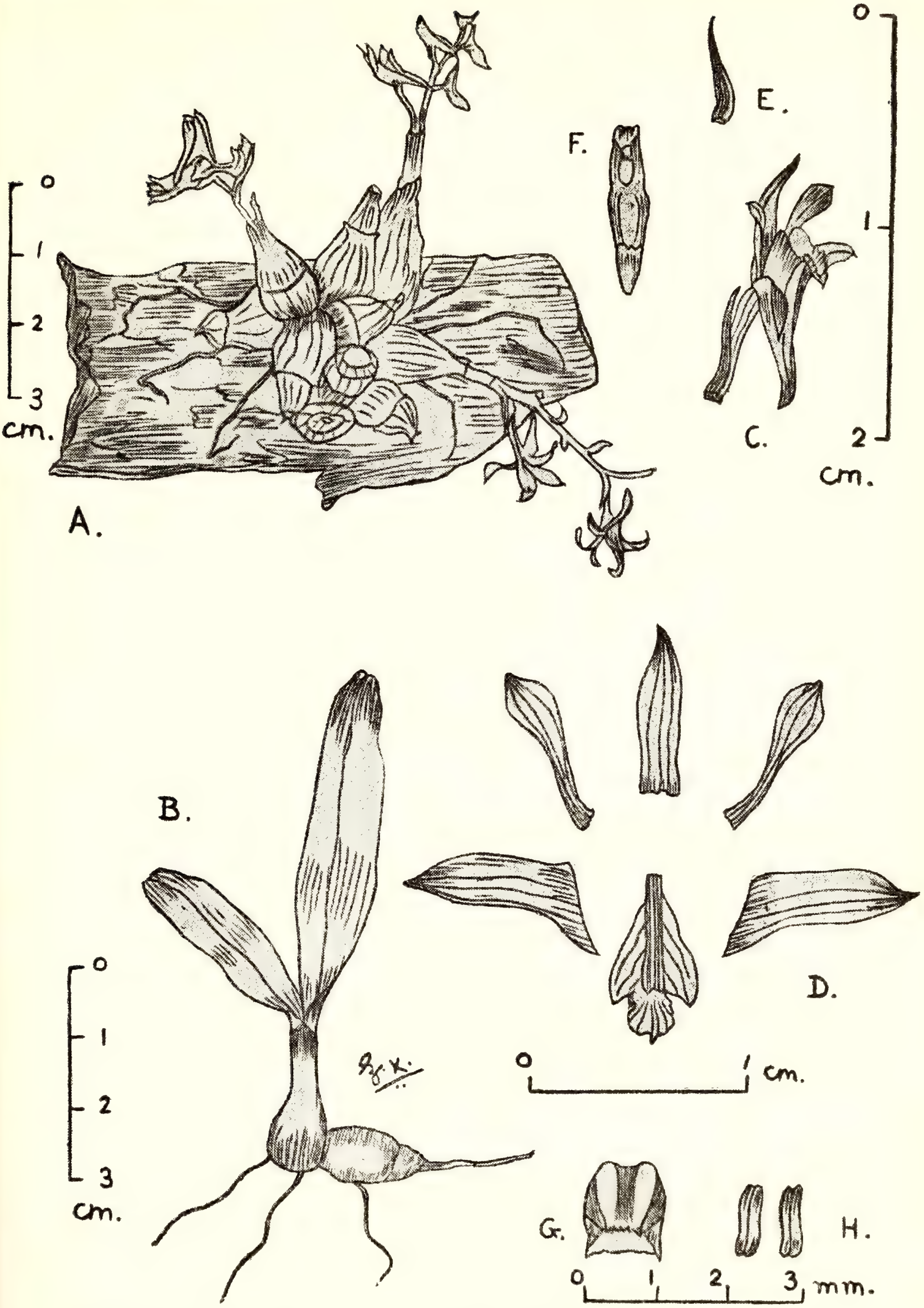
Habenaria furcifera Lindl. A. Entire plant ; B. Lateral view of the flower ; C. Calyx and corolla ; D. Floral bract ; E. Front view of column ; F. Fruit ; G. Pollinium.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Dendrobium peguanum Linn. A. Clump of pseudobulbs with inflorescence ; B. Leafy shoot ; C. Flower ; D. Calyx and corolla ; E. Floral bract ; F. Column showing anther, stigmatic surface, and foot with nectary ; G. Anther ; H. Pollinia.

a few oblong-lanceolate membranous sheaths at the base. *Flowers* bracteate and pedicellate; bracts unequal, becoming smaller upwards, 4-6 mm. long, 2 mm. broad, pale brown, membranous, about as long as the ovary or a little shorter, acuminate, lanceolate, entire, glabrous, 1-nerved; pedicels together with ovary 5-6 mm. long, straight or slightly curved, deep green. *Sepals* subequal, white tinged with green or purplish towards the base, acute, entire, glabrous, 1-nerved; the two lateral sepals 7-9 × 1-2 mm., the dorsal one 7-9 × 1-3 mm., oblanceolate. *Mentum* 3-5 mm. long, cylindrical or subconical, obtuse. *Petals* 7-9 × 1-2 mm., white, falcate, spathulate, narrowly linear at the base, suddenly dilating a little beyond the middle, obtuse or subacute, glabrous, 3-nerved. *Lip* 8-10 × 5 mm., shortly clawed at the base, dilating cuneately and 3-lobed; lateral lobes 6 × 1 mm., erect, parallel with the column, narrowly oblong, obtuse, entire, deep green with slightly swollen reddish nerves on the inside; midlobe 3 × 4 mm., deflexed, broadly triangular or triangular ovate, acute, crisped, deep amethyst in colour. *Disc* ridged, 3-nerved, greenish-white, ending in a truncate or slightly retuse, upturned callus. *Column* 2 mm. long, green, deep amethyst at the top; foot 6 mm. long, deep green with deep amethyst markings on the inner subconcave side, with a nectary at the base, which is 2 mm. long, pouch-like. *Anther* small, deep mauve or amethyst, oblong-conical, firmly affixed on the top of the column; anterior lip minutely denticulate. Pollinia 4, minute, golden-yellow, narrow-oblong. Stigmatic surfaces quadrately orbicular, deep green with amethyst margins. *Capsule* 15 × 7 mm., obovate-globular, greenish brown with broad maroon bands. (Plate V.)

Flowers: Monsoon season.

Occurrence in Bombay: Common on *Tectona grandis* Linn. f. in the neighbourhood of Tansa Lake; common also along the road between Kasara and Igatpuri on *Tectona;* common at Pimpri and Ahwa in the Dangs Forest, epiphytic on the same support (*Kapadia* 897, 1104, 1375, 1600).

ACKNOWLEDGEMENT

The junior author, Z. Kapadia, wishes to place on record that some of the work here presented was done with the help of the subsidy given to him by the Sir Dorabji Tata Trust through the Bombay Natural History Society.

Some Observations on the Fauna of the Maldive Islands

PART V—FISHES

BY

G. PALMER

Dept. of Zoology, British Museum (Natural History)

(*With a plate*)

[*Continued from Vol.* **55** (2) : 220]

The small collection of fishes made by Major W. W. A. Phillips from the Maldive Islands is of some interest as, with the exception of Deraniyagala's publication in 1956, little has been published on the fishes of this area for almost fifty years.

121 species had previously been recorded from these Islands and this figure is now increased to 128, seven of the eleven species here reported on being new records for this area.

In this paper, Major Phillips's notes are placed in square parentheses at the end of the systematic matter and are initialed ' W.W.A.P. ' All the specimens were taken in North Malé Atoll.

APODES

MURAENIDAE

Gymnothorax meleagris (Shaw & Nodder) : Moray Eel

Shaw & Nodder 1795 Nat. Miscell. **7** ; A2 pl.220.

1 specimen, 235 mm. total length.

Widely distributed throughout the Indo-Pacific including the Red Sea. Attains a length of about four feet. New record.

[Common on the southern reef of Malé Island ; the principal food of the Eastern Grey Heron (*Ardea cinerea rectirostris*).—W.W.A.P.]

Gymnothorax pictus (Ahl) : Painted Moray Eel

Ahl 1789 Spec. ichtyol. de Mur. et Ophich. Inaug. Dissert. Uppsala : 6.

1 specimen, 350 mm. total length.

Widely distributed throughout the Indo-Pacific and has been recorded from the Red Sea. Reaches a length of two to three feet .

[Caught on the southern reef of Malé Island at low tide.—W.W.A.P.]

Gymnothorax brummeri (Blkr.) : Brummer's Moray Eel

Bleeker 1858 Nat. Tijdschr. Ned. Indie **17** : 137.

1 specimen, 535 mm. total length.

Indo-Pacific. This species is apparently quite rare in the Maldives. Attains a length of two to three feet. New record.

[The only specimen seen ; caught while fishing in the Fishery Harbour. Reported by the Maldivians to be a rare species.—W.W.A.P.]

Gymnothorax boschi (Blkr.) : Bosch's Moray Eel

Bleeker 1853 Verh. Bat. Gen. **25** : 52.

1 specimen, 330 mm. total length.

Occurring generally throughout the Indo-Pacific and reaching a length of over two feet. New record.

[Taken on the southern reef of Malé Island, at low tide.—W.W.A.P.]

OPHICHTHIDAE

Myrichthys colubrinus (Boddaert) : Serpent Eel

Boddaert 1781 Neue Nord. Beitrage **2** : 56 pl.2 fig. 3.

1 specimen, 460 mm. in total length.

This species is widely distributed in the tropical Indo-Pacific, including the Red Sea. The striking colour pattern of the alternate light and dark vertical bands is subject to considerable variation. Attains a length of three feet.

[Caught inside the reef of Hululé Island, North Malé Atoll ; not so common as the following species.—W.W.A.P.]

Leiuranus semicinctus (Lay & Bennett) : Half-banded Serpent Eel

Lay & Bennett 1839 in Beechey's Voyage ; 66 pl. 20 fig. 4.

7 specimens ranging in length from 236-480 mm.

Widely distributed throughout the Indo-Pacific. This is an agile fish, which frequently burrows in the sand. Reaches a length of one to two feet. New record.

[Moderately plentiful on the southern reef of Malé Island. Seen moving slowly amongst the low-growing sea-weed, in pools left by the receding tide.—W.W.A.P.]

SOLENICHTHYES

SYNGNATHIDAE

Corythoichthys fasciatus (Gray) : Banded Pipe-fish

Gray 1830-32 Illustr. Indian Zool. **1** : 89 figs. 2 and 2a.

4 specimens, ranging in length from 68-99 mm.

This is a small species, reaching a length of six to seven inches, found generally throughout the Indo-Pacific. Has been recorded from the Red Sea. New record.

[Plentiful in small pools, with sandy bottoms, on the southern reef of Malé Island, at low tide.—W.W.A.P.]

PERCOMORPHI

SCOMBROIDEA

ISTIOPHORIDAE

Istiophorus gladius Bloch : Sail fish

Bloch 1793 Nat. ausl. Fische **7** : 81 pl. 345

Maldivian Name : Fung Hibar

Recorded from photographs of specimens, taken by W.W.A.P. Open water fishes, found in most warm seas. Attains a length of about 12 feet.

[Plentiful in the seas around Malé ; frequently brought to the fish market for sale.—W.W.A.P.]

Makaira marlina Jordan & Evermann : Black Marlin

Jordan & Evermann 1926 Occ. Pap. Acad. Sci. Calif. No. 12 : 59 17.

Maldivian Name : Hibar

Recorded from photographs of specimens, taken by W.W.A.P.

Open water fishes, widely distributed in most warm seas. Attains a length of about 14 feet.

[Plentiful in the seas around Malé ; frequently brought in to the fish market.—W.W.A.P.]

BLENNIOIDEA

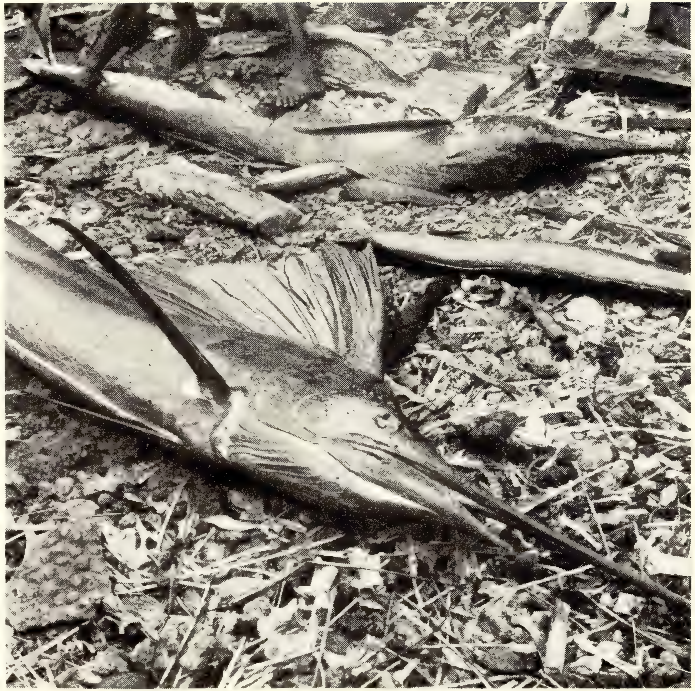
CARAPIDAE

Encheliophis (Jordanicus) gracilis (Blkr.) : Fierasfer

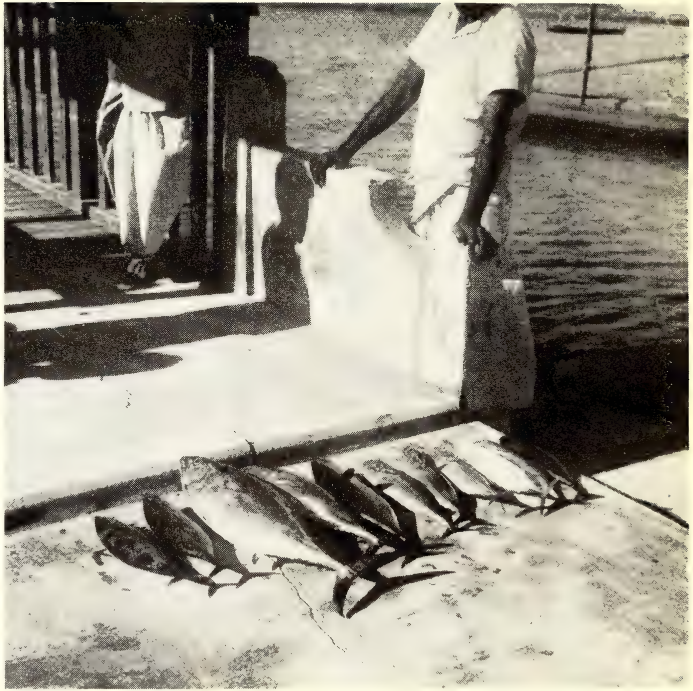
Bleeker 1856 Nat.Tijdschr. Ned. Inde. **11** : 105.

2 specimens.

Distributed throughout the Indo-Pacific and has also been recorded from the Red Sea. These interesting fishes normally live in the body cavity of a host, usually a holothurian. This particular species has been reported as inhabiting the body cavity of a starfish. It reaches a length of about nine inches. New record.



Sail-fish in the Fish-market, Malé



Bonito (*Enthynnus* sp.) caught in the lagoon of North Malé Atoll

Photos : W. W. A. Phillips

SCLEROPAREI

SCORPAENIDAE

Dendrochirus brachyptera (C.V.) : Scorpion Fish

Cuvier & Valenciennes 1829 Hist. nat. Poissons **4** : 368

4 specimens, 91–120 mm. in total length.

Widespread in tropical Indo-Pacific waters. These fishes are brightly coloured and should be handled with care, as a wound from one of the sharp spines can be extremely painful. Attains a length of about seven inches. New record.

[Caught on the reef of Malé Island by fishermen, who regard them as very poisonous.—W. W. A. P.]

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PART VI — INSECTS

BY

W. W. A. PHILLIPS

I am greatly indebted to the various specialists at the British Museum (Natural History), who have worked out the collections that I brought back from the Maldive Islands and have identified the material. Also to Dr. W. E. China, M.A., SC.D., the Keeper of Entomology, for all his assistance in connection with them. The collections themselves have been donated to the British Museum (Natural History).

MOTHS — LEPIDOPTERA NOCTUA

All the Moths, listed in the following pages, were taken on islands within the North Malé Atoll; the majority of them were collected on Malé Island, the seat of the Maldivian Government. For a description of the locality and the Maldivian Archipelago reference should be made to *JBNHS* Vol. 55 (1) : 1-3. Against each species is given the name of the island, upon which it was taken.

Most of the specimens were captured amongst low vegetation and the lower branches of trees, by the beating method. Some were, however, taken by night. Sugaring was tried on the trunks of large trees growing in the Guest-house compound, at Malé, but without success.

The whole of the collection was made between the end of November 1956 and the middle of February 1957. As many species as possible were collected but a few species were seen, especially amongst the Sphingidae, that evaded capture.

The insect fauna as a whole, and the Lepidoptera in particular, of the Maldives, appear to be very similar to the corresponding fauna of the Indian peninsula and Ceylon but the known ranges of many species will be extended by this paper.

The following is a list of the specimens collected :

	NAME OF SPECIES	SEX		
		♂	♀	
Arctiidae				
Utetheisa	*pulchelloides* Hampson subsp. .. The Maldive subspecies is closely related to *U. p. pulchelloides* occurring in the Seychelles Is. and the Chagos Archipelago.	14	20	Fujoadee I.
Utetheisa	*l. lotrix* Cramer ..	19	17	Malé I.
Hypsidae				
Deilemera	*lacticinea* Cramer ..	1		Hululay I.
Noctuidae				
Leucania	*albistigma* Moore ..	1		At sea, near Kuda Boudos I.
,,	,, ,, ..		1	Malé I.
Calogramma	*festiva* Donovan ..	5		Malé I.
Chasmina	*candida* Walker ..	1	1	Malé I.
,,	,, ,, ..	1		Gardu I.
Amyna	*punctum* Fabricius ..	1		Gardu I.
,,	,, ,, ..	1		Hululay I.
Bombotelia	*jocosatrix* Guenée ..	1	1	Malé I.
Xanthodes	*graellsii* Feisthamel ..	1		Malé I.
Grammodes	*hyppasia* Cramer ..		1	Malé I.
Euclidisema	*mygdon* Cramer ..		7	Malé I.
,,	,, ,, ..		1	Hululay I.
,,	,, ,, ..		1	Hulule I.
Ericeia	*pertendens* Walker ..		1	Malé I.
Gesonia	*obeditalis* Walker ..	1		Malé I.
Cosmophila	*flava* Fabricius ..	1		Malé I.
Cosmophila	*sabulifera* Guenée ..		6	Malé I.
Hypena	*ignotalis* Walker ..	1		Malé I.
Hyblaeidae				
Hyblaea	*puera* Cramer ..	7	4	Hulule I.
Sphingidae				
Macroglossum	*gyrans* Walker ..	4		Hulule I.
,,	,, ,, ..	3		Malé I.

	NAME OF SPECIES	SEX		
		♂	♀	
Geometridae.				
Thalassodes	*immissaria* Walker . .	4	1	Malé I.
Scopula	*caesaria* Walker . .	1		Malé I.
,,	,, ,,	1		Hulule I.
Hyperythra	*lutea* Stoll . .		1	Willinggillie I.
Limacodidae.				
Macroplectra	*nararia* Moore . .	1		Malé I.
Thyrididae.				
Striglina	*scitaria* Walker . .		4	Hululay I.
Pyralidae.				
Bradina	*admixtalis* Walker . .	1		Malé I.
Bradina	*acrospila* Meyrick . .	14	6	Malé I.
,,	,, ,,	1		Lankcumfurri I.
Nymphula	*stagnalis* Zeller . .	2		Malé I.
Earrhyparodes	*tricoloralis* Fabricius . .	1		Malé I.
Sylepta	*derogata* Fabricius . .	8	7	Hululay I.
,,	,, ,,	6	4	Hulule I.
,,	,, ,,	1		Gardu I.
,,	,, ,,	30	17	Malé I.
Dichocrocis	*punctiferalis* Guenèe . .	1	2	Malé I.
Margaronia	*suralis* Lederer . .	3	2	Gardu I.
,,	,, ,,	1		Hulule I.
,,	,, ,,		2	Hululay I.
,,	,, ,,		2	Lankcumfurri I.
,,	,, ,,		1	Malé I.
Margaronia	*caesalis* Walker . .	1		Malé I.
Tortricidae				
Argyroploce	*aprobola* Meyrick (det. *J. D. Bradley*) . .	3	3	Malé I.

Three Pyralidae (Phycitinae) remain indeterminable.

HEMIPTERA

All the species, given in the attached list were taken in Malé Island or on the islands close by, in the North Malé Atoll.

I am greatly indebted to Miss G. M. Day for making the identifications.

Suborder HETEROPTERA

PENTATOMIDAE

Piezodorus rubrofasciatus Fabr.

(India, SW. China, Philippine Is., Japan, Society Is., Samoan Is.)

Plautia fimbriata Fabr.
(Indo-China, China, India, Malaya)

Acrosternum graminea Fabr.
(India and Ceylon)

PYRRHOCORIDAE

Dysdercus cingulatus Fabr.
(India, Burma, Malaysia, Australia)

REDUVIIDAE

Triatoma rubrofasciatus de Geer
(S. China, Siam, W. Indies, Burma, India, Ceylon, Borneo, Philippine Is.)

MIRIDAE

Creontiades pallidifer Walk.
(Ceylon, China, India, Malaya, Christmas Is.)

Eurystylus bellevoyei Reut.
(Africa, India, and Ceylon)

Suborder HOMOPTERA

FLATIDAE

Melicharia obtusangula Dist.
(India and Ceylon)

CICADELLIDAE

Parabolocratus arcuatus Motsch
(India, Ceylon and Queensland)

Freshwater Diatoms from Kolhapur and its immediate Environs[1]

BY

H. P. GANDHI

M. N. College, Visnagar, N. Gujarat

(*With fifty-one figures*)

INTRODUCTION

There are no records available of the freshwater diatom flora of Kolhapur, except for one on soil diatoms by the present author (1956). It is, therefore, considered desirable to survey the freshwater flora of the said area. This account is based on extensive collections made by the author during 1951-56, from many permanent, temporary, and ephemeral bodies of water in and around the city.

Kolhapur is a prosperous city and a vital hub of commerce to many towns and villages extending far beyond the Western Ghats. It lies on latitude 16° 42′ N. and longitude 74° 16′ E. at the terminus of the Miraj-Kolhapur section of the Southern Railway, on a plateau approximately of 1500 feet elevation. The annual average rainfall is 35 inches, the bulk of which is received during the monsoon. The climate is moderate. The geology is essentially of the Deccan Trap.

Material collected practically from all possible wet situations in and around the city was examined at the Rajaram College, Kolhapur, during 1953-56. While examining the material, it became evident that many forms found here are also recorded from Bombay and Salsette (Gonzalves and Gandhi, 1952-54), some of them widely distributed.

The classification and indentification of the forms has been done according to Hustedt's (1930) and Cleve-Euler's (1951-55) monographs. Besides these major works, Van Heurck's TREATISE ON DIATOMACEAE and several other works and papers have been referred to in preparation of this paper.

The dimensions given for the individual forms are those actually recorded. At the end of this paper a table is given suggesting the distribution of these diatoms in the said area and elsewhere in India as recorded by previous workers.

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[1] [Article 35 of the *International Code of Botanical Nomenclature*, 1956 edition, reads as follows : ' Publication on or after 1 Jan. 1958 of the name of new taxon of recent plants of the rank of order or below is valid only when the nomenclatural type is indicated (see Arts. 7—10).' Accordingly the various new forms published in this paper, even when the Latin description is supplied, must be considered as not validly published.—EDS.]

Family COSCINODISCACEAE

1. **Melosira granulata** (Ehr.) Ralfs (Figs. 1-2)

Van Heurck, Treat. Diat. 444, t. 19, f. 621 ; Hustedt, Bacil. 87, f. 44 : Cleve-Euler, A., Diat. Schwed. Finn.—I : 25, f. 15 a-b (= *M. granulata* v. *typica* A. Cl.).

Frustules 6-10 μ in diameter, semi-cell 12-14 μ high, cylindrical, united in short or long chains. End cell with spines and furrows, and straight rows of areoles, 8-10 in 10 μ ; other cells have 9-11 rows in 10 μ, spirally disposed.

2. **Melosira granulata** v. **muzzanensis** Meister (Fig. 3)

Hustedt, Bacil. 88, f. 47 ; Cleve-Euler, A., Diat. Schwed. Finn.—I : 25, f. 15 f.

Frustules 14-16 μ in diameter, semi-cell 10-11 μ high, short-cylindrical or discoid, otherwise like the type. Rows of areoles 9-10 in 10 μ.

3. **Cyclotella meneghiniana** Kütz. f. **binotata** Grun. (Fig. 4)

Cleve-Euler, A., Diat. Schwed. Finn.—I : 48, f. 63 c (= C. *meneghiniana* v. *genuina* A. Cl. f. *binotata* Grun.).

Valves 13-16 μ in diameter, discoidal. Central field inconspicuously punctate with two distinct dots. Striae 8-9 in 10 μ, thick and radial.

The varietal epithet ' v. *genuina* ' which refers to the type proper is eliminated since it is out of vogue.

Family FRAGILARIACEAE

4. **Fragilaria rumpens** (Kütz.) Carlson v. **familiaris** (Kütz.) A. Cl. (Figs. 5-6)

Cleve-Euler, A., Diat. Schwed. Finn.—II : 42, f. 352 c-e ; Hustedt, Bacil. 156, f. 176 [= *Synedra rumpens* Kütz. v. *familiaris* (Kütz.) Grun.].

Valves 69-96 μ long and 2.7-3 μ broad, narrowly lanceolate, walls twice constricted in the middle with ends produced and somewhat capitate. Pseudoraphe narrow. Central area present. Striae 17-19 in 10 μ, fine.

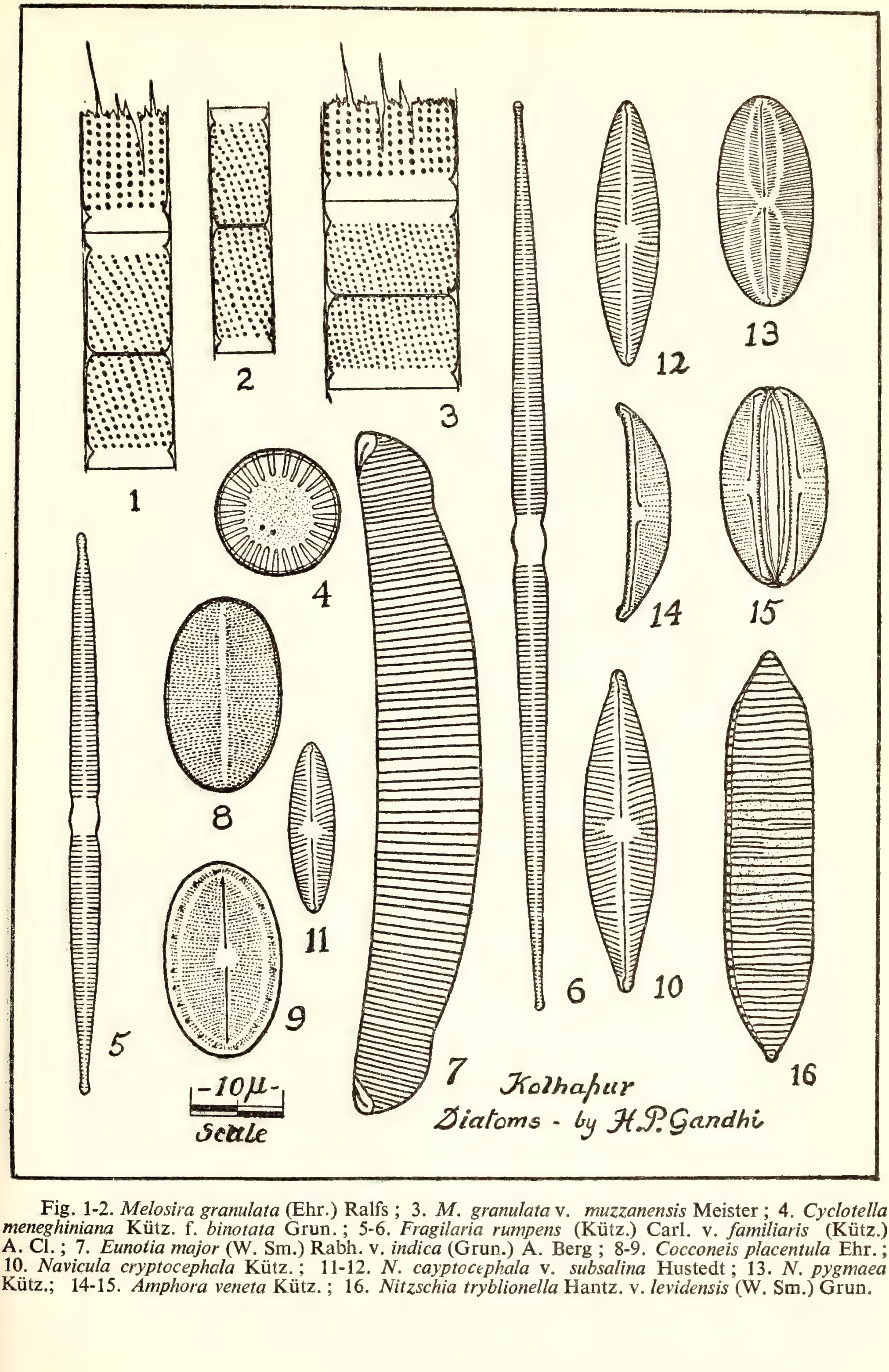
The form agrees well with the type except that some forms found in this region were definitely longer than those recorded in the literature.

5. **Synedra ulna** (Nitz.) Ehr. v. **subaequalis** Grun. (Fig. 17)

Cleve-Euler, A., Diat. Schwed. Finn.—II : 61, f. 382 f-i.

Valves 300-495 μ long and 6.5-8 μ broad, linear, slightly bent with narrowed, constricted, produced broadly subcapitate ends. Pseudoraphe narrow, linear ; central area present or absent. Striae 8-9 in 10 μ, coarse.

FIGURES 1-16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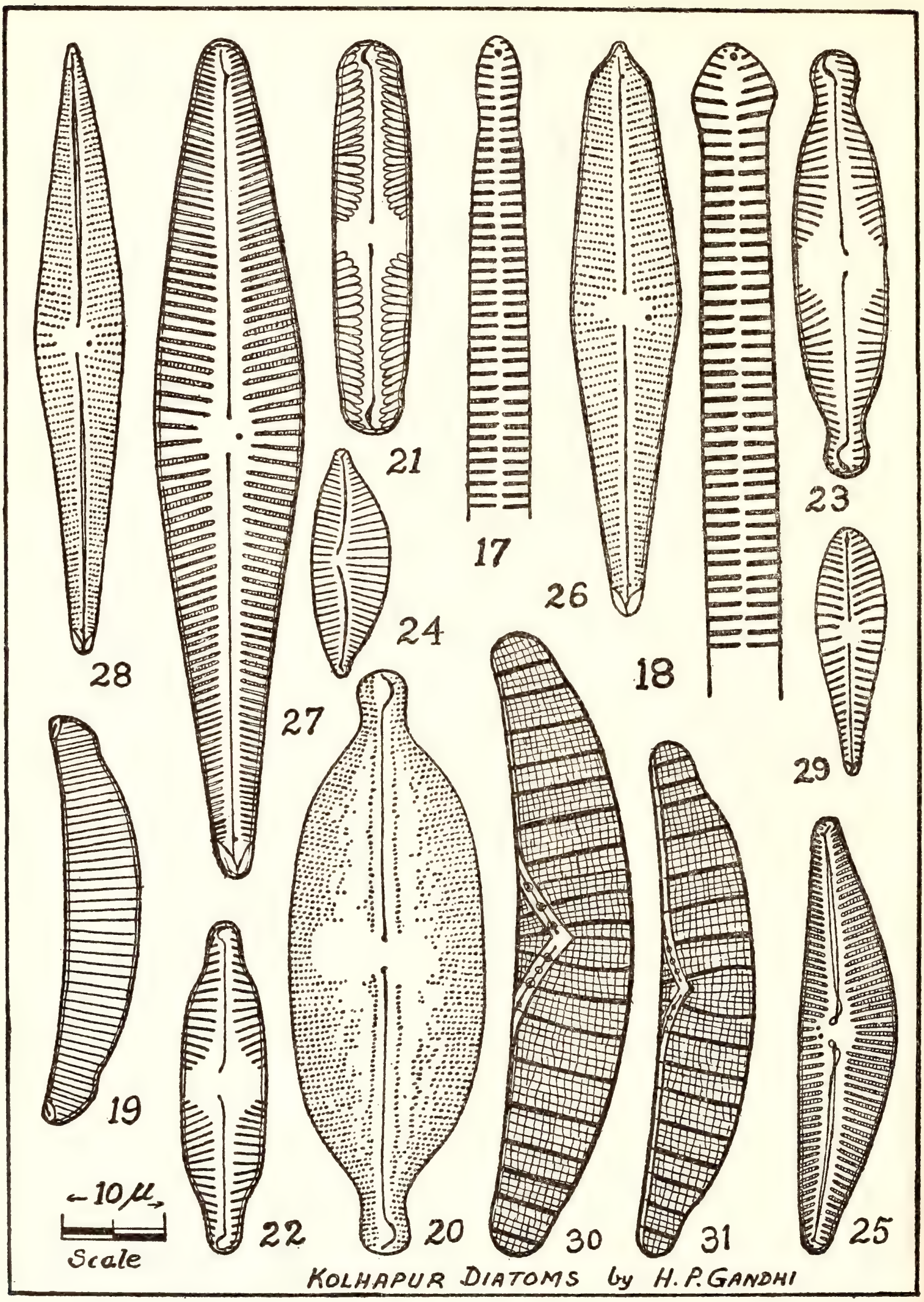
Diatoms - by H.P. Gandhi

Fig. 1-2. *Melosira granulata* (Ehr.) Ralfs ; 3. *M. granulata* v. *muzzanensis* Meister ; 4. *Cyclotella meneghiniana* Kütz. f. *binotata* Grun. ; 5-6. *Fragilaria rumpens* (Kütz.) Carl. v. *familiaris* (Kütz.) A. Cl. ; 7. *Eunotia major* (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg ; 8-9. *Cocconeis placentula* Ehr. ; 10. *Navicula cryptocephala* Kütz. ; 11-12. *N. cayptocephala* v. *subsalina* Hustedt ; 13. *N. pygmaea* Kütz.; 14-15. *Amphora veneta* Kütz. ; 16. *Nitzschia tryblionella* Hantz. v. *levidensis* (W. Sm.) Grun.

FIGURES 17-31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KOLHAPUR DIATOMS by H. P. GANDHI

Fig. 17. *Synedra ulna* (Nitz.) Ehr. v. *subaequalis* Grun. ; 18. *S. ulna* v. *biceps* Kütz. ; 19. *Eunotia major* (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg ; 20. *Anomoeoneis sphaerophora* (Kütz.) Pfit. ; 21. *Pinnularia kolhapurensis* sp. nov. ; 22. *P. notata* (Perag. & Hèr.) A. Cl. v. *rostrata* A. Cl. ; 23. *P. biceps* Greg. v. *amphicephala* (May.) A. Cl. ; 24. *Cymbella kerkevarensis* A. Cl. ; 25. *C. tumidula* Grun. ; 26. *Gomphonema subapicatum* Fritsch & Rich. ; 27. *G. lanceolatum* Ehr. ; 28. *G. spicula* sp. nov. ; 29. *G. olivaceum* (Lyng.) Kütz. ; 30. *Epithemia zebra* (Ehr.) Kütz. ; 31. *E. zebra* v. *proboscidea* (Kütz.) Grun.

6. **Synedra ulna** v. **biceps** Kütz. (Fig. 18)

Hustedt, Bacil. 154, f. 166 ; Cleve-Euler, A., Diat. Schwed. Finn.—II : 62, f. 382 1.

Valves 250-425 μ long and 6-7 μ broad, linear, bent in the middle, with swollen, broadly subcapitate ends. Pseudoraphe narrow. Striae 7-8 in 10 μ, very coarse.

Family EUNOTIACEAE

7. **Eunotia major** (W. Sm.) Rabh. v. **indica** (Grun.) Å. Berg (Figs. 7, 19)

Berg. Å., *Bot. Not.* 1939 : 452 ; Cleve-Euler, A., Diat. Schwed. Finn.—II : 120, f. 456 r.

Valves 38-68 μ long and 7.7- 10μ broad, sublinear, arcuate with ventral side concave and dorsal side convex, ends constricted on the dorsal side, obliquely capitate-wedge-shaped. Polar nodules small. Striae 9-10 in the middle and 12-14 in 10 μ, at the ends.

Family ACHNANTHACEAE

8. **Cocconeis placentula** Ehr. (Figs. 8-9)

Hustedt, Bacil. 189, f. 260 a-b ; Cleve-Euler, A., Diat. Schwed. Finn.—III : 8, f. 492 a-b (= *C. placentula* v. *genuina* Mayer).

Valves 15-30 μ long and 10-16 μ broad, elliptical. Valve with raphe : raphe thin and straight ; axial area very narrow ; central area small, roundish ; striae 27 in 10 μ, finely punctate, marginal rim distinct. Valve without raphe : pseudoraphe narrow, linear ; striae 23-25 in 10 μ, interrupted by many closely placed longitudinal, somewhat wavy hyaline bands.

Family NAVICULACEAE

9. **Mastogloia recta** Hustedt (Fig. 32)

Voigt, M., *J. roy. microsc. Soc.* 75 : 191, t. 2, f. 3.

Valves 41-47 μ long and 13-13.5 μ broad, linear-elliptical with slightly constricted, produced obtusely rounded ends. Raphe thick, complex with slightly unilaterally bent central pores. Axial area narrow, linear ; central area fairly large, roundish. Belt of loculi arcuate, slightly away from the margins ; loculi 9-10 in 10 μ, each loculus 1-1.3 μ long and 2-3 μ broad. Striae 12-14 in 10 μ, radial throughout or sometimes inconspicuously convergent at the extreme ends, coarse and clearly punctate, 1-2 median striae smaller or deformed.

This form agrees well with the type (photomicrograph) given by Voigt, except that the margins are feebly convex and the ends slightly produced.

10. **Mastogloia recta** v. **pulchella** Voigt (Figs. 33-35)

Voigt, M., *J. roy. microsc. Soc.*, 75 : 191, t. 2, f. 4.

Frustules epiphytic on *Chara*, united in short ribbons, broadly rectangular in girdle view with two longitudinal belts of loculi. Valves 24-35 μ long and 11-13 μ broad, broadly lanceolate with slightly constricted, produced obtuse ends. Raphe, central and axial areas as in the type. Loculi 8-9 in 10 μ, each loculus except the end ones, 1-1.2 μ long and 2-3 μ broad. Striae 13-14 in 10 μ radial throughout or at the extreme ends 2-3 striae either perpendicular or convergent, coarse and clearly punctate, punctae 22-23 in 10 μ, 1-2 median striae smaller or somewhat deformed.

11. **Anomoeoneis sphaerophora** (Kütz.) Pfitzer (Fig. 20)

Hustedt, Bacil. 262, f. 422 ; Cleve-Euler, A., Diat. Schwed. Finn.—III: 202, f. 928 a (=*A. sphaerophora* v. *genuina* A. Cl.).

Valves 50-55 μ long and 17-18.5 μ broad, sub-elliptical to elliptical lanceolate with narrowed, produced, slightly capitate ends. Raphe thin with curved central pores. Axial area very narrow ; central area large, unilaterally widened. Striae 16-18 in 10 μ, coarsely punctate, towards the axial part interrupted by broad, irregular, longitudinal wavy hyaline bands.

12. **Navicula cuspidata** Kütz. f. **brevirostrata** f. nov. (Fig. 36)

Valvae 58.8-68 μ longae atque 18-20 μ latae, elliptico-lanceolatae, apicibus constrictis ac brevi-rostrato-subtruncatis. Raphe tenuis et recta, poris centralibus hamo-similibus. Area axialis angustissima, linearis ; area centralis vix evoluta. Striae transversales 14-16 in 10 μ, plerumque perpendiculares ad lineam mediam, striae longitudinales tenuissimae, indistinctae, circa 26-28 in 10 μ.

Valves 58.8-68 μ long and 18-20 μ broad, elliptic-lanceolate with constricted, shortly rostrate subtruncate ends. Raphe thin and straight with central pores hook-like. Axial area very narrow, linear ; central area scarcely formed. Striae transverse 14-16 in 10 μ, mostly perpendicular to the middle line, longitudinal striae very fine, almost indistinct, about 26-28 in 10 μ.

A few frustules observed in the collection, differed from the type in being more elliptical-lanceolate with constricted, shortly rostrate-subtruncate ends. Hence, such specimens have been tentatively regarded as a new form.

13. **Navicula cuspidata** v. **ambigua** (Ehr.) Cl. (Fig. 37)

Hustedt, Bacil. 268, f. 434 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 18, f. 1353 g (=*N. cuspidata* Kütz. v. *ambigua* (Ehr.) Cl. f. *crati-*

cularis A. Cl.) ; Van Heurck, Treat. Diat. 214, t. 4, f. 193 (=*N. ambigua* Ehr. f. *craticula* V. H.).

Valves 81-91 μ long and 17-18 μ broad, narrowly rhombic-lanceolate with constricted, produced feebly capitate ends. Craticular plates sometimes present. Raphe thin and straight with central pores hook-like. Axial area very narrow, linear ; central area scarcely formed. Striae transverse 16-17 in 10 μ, almost perpendicular to the middle line, longitudinal striae fine, almost indistinct, about 28 in 10 μ.

This form appears to be slender as compared to Hustedt's form but agrees well with others. In some forms craticular plates were also observed as indicated by Van Heurck and Cleve-Euler in their illustrations and such forms they have regarded as forma *craticula* and f. *craticularis*, respectively. Here, these forms have been included under *N. cuspidata* v. *ambigua* (Ehr.) Cl., since craticular stages are immobile stages induced under unfavourable conditions of the environment. (Smith, G. M., Cryptogamic Botany, II : 207).

14. **Navicula minuta** (Cleve) A. Cl. (Fig. 38)

Cleve-Euler, A., Diat. Schwed. Finn.—III : 142, f. 791 a (=*N. minuta* v. *genuina* A. Cl.).

Valves 19-20 μ long and 7 μ broad, broadly lanceolate with constricted, shortly capitate ends. Raphe thin and straight with central pores closely set. Axial area very narrow ; central area small, roundish. Striae 22-24 in 10 μ, radial and fine.

This diatom agrees well with the type, except that it is somewhat smaller in dimensions. It also compares well with *N. carassius* Ehr., as described by Donkin (Donkin, Brit. Diat. 20, t. 3, f. 7), in the outline. But as the dimensions are not indicated, the comparison is difficult. Moreover, the ends are described to be produced which are here capitate, hence it differs.

15. **Navicula cryptocephala** Kütz. (Fig. 10)

Hustedt, Bacil. 295, f. 496; Cleve-Euler, A., Diat. Schwed. Finn.—III : 154, f. 813 a-e (= *N. cryptocephala* v. *genuina* A. Cl.).

Valves 27-44 μ long and 6-7 μ broad, lanceolate with somewhat constricted produced ends. Striae 14-17 in 10 μ, lineate, radial in the middle and convergent at the ends.

16. **Navicula cryptocephala** v. **subsalina** Hust. (Figs. 11-12)

Cleve-Euler, A., Diat. Schwed. Finn.—III : 154, f. 813 i-j, n.

Valves 18-27 μ long and 5-6.6 μ broad, lanceolate with rounded ends. Raphe thin and straight. Axial area very narrow, linear ; central area small, elliptical. Striae 14-17 in 10 μ, radial in the middle and convergent at the ends, lineate.

17. **Navicula pygmaea** Kütz. (Fig. 13)

Hustedt, Bacil, 312, f. 561; Cleve-Euler, A., Diat. Schwed. Finn.—III: 105, f. 708.

Valves 18-25 μ long and 9-10 μ broad, elliptical. Raphe thin and straight with central pores closely set and distinct. Axial area very narrow; central area small, rectangular. Striae 26-28 in 10 μ, radial, interrupted in the axial region by a H-shaped hyaline area.

18. **Pinnularia kolhapurensis** sp. nov. (Fig. 21).

Valvae 36-40 μ longae atque 8.5 μ latae, sublineares, apicibus aliquantum constrictis, productis atque truncato-rotundatis. Raphe tenuis et recta, ornata poris centralibus unilateraliter inclinatis, fissuris terminalibus aliquantum curvatis. Area axialis angusta ; area centralis lata, rhomboidea ad latera perveniens. Striae 11-13 in 10 μ, crassae, proximae positae, radiales in medio ac convergentes in utroque apice.

Valves 36-40 μ long and 8.5 μ broad, sublinear with slightly constricted, produced, truncate rounded ends. Raphe thin and straight with unilaterally bent central pores and slightly curved terminal fissures. Axial area narrow ; central area wide, rhomboid, reaching the sides. Striae 11-13 in 10 μ, thick, closely set, radial in the middle and convergent at the ends.

This form remotely resembles *P. subcapitata* Greg. (Hustedt, Bacil. 317, f. 571; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 64, f. 1090 a-b) (=*P. subcapitata* v. *genuina* A. Cl.); Lund, J. W. G., *New Phytol.* 45: 90, f. 10 T-V), in the outline and somewhat in ends. However, the present form appears to be distinctive, as it is proportionately much broader than *P. subcapitata*, besides having closely set striae and rhomboidal central area. Hence it is tentatively considered to be a new species.

19. **Pinnularia notata** (Perag. & Hér.) A. Cl. v. **rostrata** A. Cl. (Fig. 22)

Cleve-Euler, A., Diat. Schwed. Finn.—IV : 56, f. 1075 e-f, k.

Valves 27-35 μ long and 8-8.5 μ broad, linear with somewhat abruptly constricted, produced rounded ends. Raphe thin and straight. Axial area narrow, linear ; central area very large reaching the sides. Striae 10-12 in 10 μ, coarse, radial in the middle and convergent at the ends.

This diatom agrees well with the type, except that some smaller forms were also recorded in the area.

20. **Pinnularia biceps** Greg. v. **amphicephala** (May.) A. Cl. (Fig. 23)

Cleve-Euler, A., Diat. Schwed. Finn.—IV : 63, f. 1088 i; Hustedt, Bacil. 319, f. 578 [= *P. braunii* (Grun.) Cl. v. *amphicephala* (A. Mayer) Hustedt].

Valves 42-45 μ long and 8.5-9 μ broad, sublinear with slightly convex sides and constricted capitate ends. Raphe thin and straight with central pores unilaterally bent and closely set; terminal fissures curved. Axial area narrow; central area very large, rhomboid, reaching the sides. Striae 10-12 in 10 μ, coarse, radial in the middle and convergent at the ends.

The form recorded from this area agrees well with the type, except that they are slightly broader.

21. **Amphora veneta** Kütz. (Figs. 14-15)

Hustedt, Bacil. 345, f. 631 ; Cleve-Euler, A., Diat. Schwed. Finn.—III : 96, f. 682,

Frustules 13-24 μ long and 8-10 μ broad, broadly elliptical with somewhat subtruncate ends in the girdle view. Valves 4-4.5 μ broad, strongly convex on the dorsal side and slightly concave on the ventral margin with inwardly bent rounded ends. Raphe thin, very close to the ventral margin with central pores dorsally directed. Striae 16-20 in 10 μ, in the middle and up to 27 at the ends, median striae clearly punctate, end striae very finely punctate and rather indistinct, radial throughout. Ventral margin very shortly punctate.

This form is described by Krishnamurthy (1954) where he indicates that the frustules have constriction in the middle zone. However, the present author observed no such constrictions in any of his forms collected from several places, and he finds no such point mentioned either by Hustedt (1930) or Cleve-Euler (1953).

22. **Cymbella kerkevarensis** A. Cl. (Fig. 24)

Cleve-Euler, A., Diat. Schwed. Finn.—IV: 146, f. 1215.

Valves 22-25 μ long and 7.7-8 μ broad, asymmetrical with strongly convex dorsal side and slightly convex ventral side, ends slightly constricted and rostrate. Raphe thin, slightly arcuate or apparently straight, excentric and strongly marked. Axial area very narrow; central area very small. Striae 11-13 in 10 μ, throughout radial and finely punctate.

This form agrees well with the type, except that it is somewhat smaller in dimensions.

23. **Cymbella tumidula** Grun. (Fig. 25)

Hustedt, Bacil. 361, f. 669; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 157, f. 1239 a-b (= *C. tumidula* v. *genuina* A. Cl.)

Valves 35-40 μ long and 8.8-9 μ broad, asymmetrical, lanceolate with strongly convex dorsal side and slightly convex ventral side ; ends constricted and produced, rounded. Raphe thick, excentric. Axial area very narrow ; central area slightly widened towards the dorsal side, ventral side with two distinct puncta. Striae 12-14 in 10 μ, radial, indistinctly punctate and somewhat closer at the ends.

24. **Gomphonema subapicatum** Fritsch & Rich. (Fig. 26)

Gandhi, H. P., *J. Indian bot. Soc.* 35 : 205, f. 22.

Valves 55-60 μ and 10-11 μ broad, lanceolate-clavate with constricted, subapiculate apex and attenuated base. Raphe thin and straight. Central area with an isolated stigma on one side. Striae 10-13 in 10 μ, radial and distinctly punctate.

25. **Gomphonema lacus-rankala** sp. nov. (Fig. 39)

Valvae 69-90 μ longae atque 18.5-20 μ latae, late lanceolato-clavatae, apice constricto, late rostrato-rotundato, ad basim concavo, attenuato-rotundato. Raphe crassa, cum portione centrali unilateraliter inclinata. Area axialis angustissima, lanceolata; area centralis aliquantum unilateralis cum unico stigmate in latere opposito. Striae 8-9 in 10 μ, radiales, crassae atque distincte punctatae, punctis 16-17 in 10 μ.

Valves 69-90 μ long and 18.5-20 μ broad, broadly lanceolate-clavate with constricted, broadly rostrate rounded apex and somewhat concave attenuated rounded base. Raphe thick with central portion unilaterally bent. Axial area narrowly lanceolate ; central area slightly unilateral with a stigma on the opposite side. Striae 8-9 in 10 μ, radial, coarse and distinctly punctate, puncta 16-17 in 10 μ.

This form bears some resemblance with *G. subapicatum* Frit. & Rich. described above, in the outline and constricted apex. However, it differs from it in having thick raphe with unilaterally bent central part, conspicuously rostrate apex, very coarsely punctate striae and some other details. It, therefore, appears to be a distinctive form, hence it is considered to be a new species.

26. **Gomphonema lacus-rankala** v. **robusta** v. nov. (Fig. 40)

Valvae 90-101 μ longae atque 18.7 μ latae, robustae, longo-lanceolato-clavatae, apice aliquantum constricto, rostrato-rotundato, ad basim attenuato, rotundato. Striae 8-10 in 10 μ, crasse punctatae, ac aliquantum radiales. In coeteris ut typus.

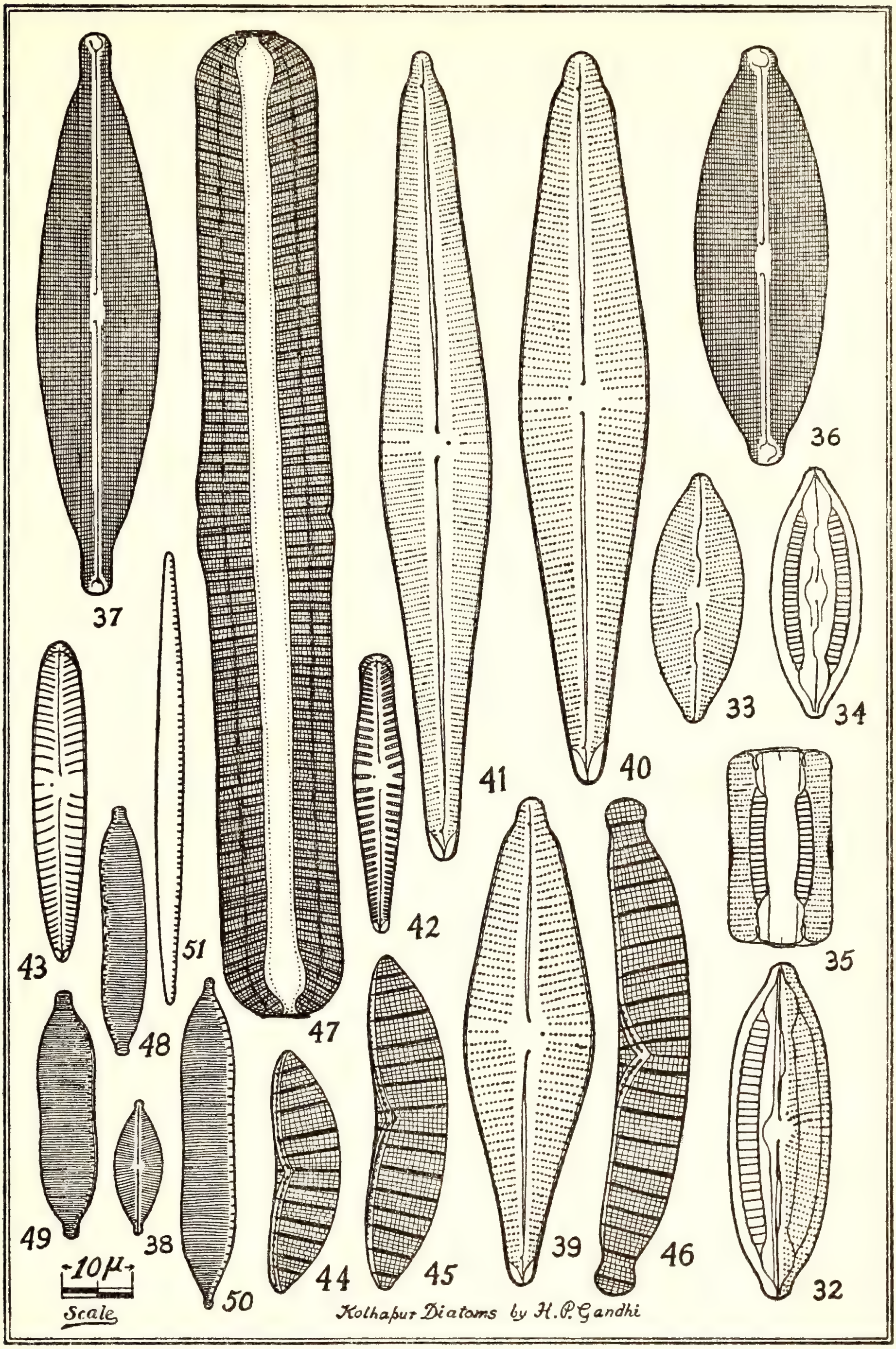
Valves 90-101 μ long and 18.7 μ broad, robust, long-lanceolate-clavate with slightly constricted, rostrate-rounded apex and attenuated rounded base. Striae 8-10 in 10 μ, coarsely punctate and slightly radial. In other details like the above type.

This form differs from the above type in being elongated, more lanceolate-clavate, robust with somewhat prominently rostrate apex. It is, therefore, regarded as a new variety of *G. lacus-rankala*, with which it occurred in a good number.

27. **Gomphonema lacus-rankala** v. **gracilis** v. nov. (Fig. 41)

Valvae 100-112 μ longae atque 15 μ latae, angustissime-lanceolato-clavatae, apice aliquantum constricto, tenuissime producto, ad basim

FIGURES 32-51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Kolhapur Diatoms by H.P.Gandhi

Fig. 32. *Mastogloia recta* Hustedt ; 33-35. *M. recta* v. *pulchella* Voigt ; 36. *Navicula cuspidata* Kütz. f. *brevirostrata* f. nov. ; 37. *N. cuspidata* v. *ambigua* (Ehr.) Cl. ; 38. *N. minuta* (Cleve) A. Cl. ; 39. *Gomphonema lacus-rankala* sp. nov. ; 40. *G. lacus-rankala* v. *robusta* v. nov. ; 41. *G. lacus-rankala* v. *gracilis* v. nov. ; 42. *G. intricatum* Kütz. ; 43. *G. intricatum* v. *bohemicum* (Reichelt & Fricke) A. Cl. ; 44-45. *Epithemia zebra* (Ehr.) Kütz. v. *frickei* A. Cl. ; 46. *E. zebra* v. *porcellus* (Kütz.) Grun. ; 47. *Rhopalodia gibba* (Ehr.) O. Müll. ; 48. *Hantzschia amphioxys* (Ehr.) Grun. v. *densestriata* (Font.) A. Cl. ; 49. *Nitzschia thermalis* Kütz. v. *minor* Hilse ; 50. *N. commutata* Grun. v. *pamirensis* (Hust.) A. Cl. ; 51. *N. gandersheimiensis* Krasske.

attenuato rotundato. Raphe, area axialis atque centralis ut in typo. Striae 8-10 in 10 μ, radiales atque punctatae, punctis 20-22 in 10 μ, striae aliquantum proxime positae in utroque apice.

Valves 100-112 μ long and 15 μ broad, narrowly-lanceolate-clavate with very slightly constricted, much produced narrower apex and attenuated rounded base. Raphe, central and axial areas as in the type. Striae 8-10 in 10 μ, radial, punctate, puncta 20-22 in 10 μ, striae somewhat closely set at the apices.

This form agrees well with *G. lacus-rankala*, in the outline, apex, raphe and striae. However, it differs from the same in being slender, with more pointed apex. Moreover, the striae have comparatively finer puncta. It is, therefore, regarded as a new variety of *G. lacus-rankala* with which it occurred in a smaller number.

28. **Gomphonema lanceolatum** Ehr. (Fig. 27)

Hustedt, Bacil. 376, f. 700 ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 184, f. 1280 a-e (= *G. lanceolatum* v. *genuinum* A. Cl.).

Valves 60-70 μ long and 12 μ broad, lanceolate-clavate with distinctly rounded apex and base, base somewhat narrower. Raphe slightly thick and straight. Axial area narrow, linear ; central area slightly unilateral with an isolated stigma on the opposite side. Striae 8-13 in 10 μ, radial and lineate.

29. **Gomphonema spicula** sp. nov. (Fig. 28)

Valvae 38-58 μ longae atque 5.5-8 μ latae, anguste lanceolato-clavatae, aliquantum arcuatae, apice acutissimo, basi gradatim fastigata. Raphe crassa, cum portione centrali unilateraliter inclinata, fissuris terminalibus distinctis. Area axialis angustissima, linearis ; area centralis quadrata, unilateralis cum unico stigmate in latere opposito. Striae 12-15 in 10 μ, radiales, distincte punctatae, punctis tenuibus sed distinctis.

Valves 38-58 μ long and 5.5-8 μ broad, narrowly lanceolate-clavate, slightly curved with very acute apex and gradually attenuated base. Raphe thick with central part unilaterally bent and terminal fissures distinct. Axial area very narrow, linear ; central area quadrate and unilateral with an isolated stigma on the opposite side. Striae 12-15 in 10 μ, radial, distinctly punctate, but fine.

This form does not agree with any of the known types of *Gomphonema*, hence, it is considered to be a new species.

30. **Gomphonema intricatum** Kütz. (Fig. 42)

Hustedt, Bacil. 375, f. 697 ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 187, f. 1283 a-d (= *G. intricatum* v. *genuinum* Mayer).

Valves 39-42 μ long and 5.5-6.7 μ broad, subclavate with constricted slightly swollen broadly rounded apex and attenuated rounded base.

Raphe slightly thick. Axial area narrow, linear ; central area unilateral with an isolated stigma on the opposite side. Striae 8-9 in 10 μ, in the middle up to 12 at the apices, radial, coarse, punctate, median striae very small and widely set.

31. **Gomphonema intricatum** v. **bohemicum** (Reich. & Fricke) A. Cl. (Fig. 43)

Cleve-Euler, A., Diat. Schwed. Finn. IV : 189, f. 2183 v-w ; Hustedt, Bacil. 377, f. 718 a-c (= *G. bohemicum* Reich. & Fricke).

Valves 40-45 μ long and 7-7.5 μ broad, linear-clavate with broadly rounded, somewhat thickened apex and acutely rounded base. Raphe thin and straight. Axial area linear ; central area unilaterally reaching the side, large with an isolated stigma on the opposite side. Striae 6-8 in 10 μ in the middle and up to 11 at the ends, slightly radial and curved, indistinctly punctate.

32. **Gomphonema olivaceum** (Lyng.) Kütz. (Fig. 29)

Hustedt, Bacil. 378, f. 719 a-c ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 192, f. 1291 f-g (= *G. olivaceum* v. *genuinum* Mayer)

Valves 20-24 μ long and 6-6.5 μ broad, clavate with broadly rounded apex and attenuated base. Raphe thin and straight. Axial area somewhat narrow ; central area moderate without an isolated stigma. Striae 8-11 in 10 μ, radial and curved.

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33. **Epithemia zebra** (Ehr.) Kütz. (Fig. 30)

Van Heurck, Treat. Diat. 296, t. 9, f. 357 ; Hustedt, Bacil. 384, f. 729 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 37, f. 1409 a-f (= *E. zebra* v. *genuina* Grun.).

Frustules free or were found as epiphyte on *Hydrilla* and *Chara*, rectangular in girdle view. Valves 40-50 μ long and 8-9 μ broad, arcuate with dorsal side convex and ventral side concave, ends very slightly or not at all constricted, narrow to obtusely rounded. Raphe in the raphe-canal reaching $\frac{1}{3}$–$\frac{1}{2}$ the breadth of the valve. Costae 3-4 in 10 μ, strong and radial, alternating with 3-5 rows rarely 2 rows of alveoli, rows of alveoli 12-13 in 10 μ.

34. **Epithemia zebra** v. **frickei** A. Cl. (Figs. 44-45)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 37, f. 1409 h ; Hustedt, Bacil. 387, f. 732 (= *E. intermedia* Fricke).

Frustules were found epiphytic on *Chara* and *Hydrilla*, rectangular in girdle view. Valves 36-49 μ long and 9.7-10 μ broad, slightly arcuate ; dorsal side convex or in larger forms somewhat straight in the middle part; ventral side more less concave; ends slightly depressed, backwardly oriented and rounded. Raphe in the raphe-canal very close to the ventral margin, slightly curved in the middle or sometimes reaching ¼ the breadth of the valve. Costae 3-4 in 10 μ, almost parallel with one another, alternating with 3-5 rows of alveoli, rows of alveoli 12-13 in 10 μ, fairly well developed.

This form is treated according to Cleve-Euler's diagnosis, since it does not show any appreciable difference with *E. zebra*, in its general organisation. Here, therefore, Hustedt's *E. intermedia* Fricke is considered to be the variety of *E. zebra*.

35. **Epithemia zebra** v. **proboscidea** (Kütz.) Grun. (Fig. 31)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 38, f. 1409 m-n.

Frustules were found epiphytic on *Chara* or *Hydrilla*, sometimes isolated rectangular in girdle view. Valves 50-53 μ long and 8-8 μ, broad, linear, arcuate with strongly constricted, produced rounded ends. Raphe in the raphe-canal reaching ⅓ the breadth of the valve. Costae 3-3.5 in 10 μ, alternating with 3-5 rows of alveoli; rows of alveoli 12-13 in 10 μ, quite distinct.

A few forms observed in the collection, none showed capitate ends as indicated by Van Heurck for his specimen (Van Heurck, Treat. Diat. 297, t. 9, f. 358). However, the present form agrees well with figure ' 1409 m ', given by Cleve-Euler, hence it is so treated.

36. **Epithemia zebra** v. **porcellus** (Kütz.) Grun. (Fig. 46)

Skvortzow, B. W., *Philipp. J. Sci.*, 65 : 416, t. 2, f. 3; Cleve-Euler, A., Diat. Schwed. Finn.—V : 38, f. 1409 q.

Frustules were found epiphytic on *Chara* and *Ceratophyllum* along with the type, rectangular in girdle view. Valves 60-71.5 μ long and 8.8-10 μ broad, slightly arcuate, linear with conspicuously constricted, broadly capitate rounded ends, sometimes ends slightly backwardly bent. Raphe in the raphe-canal reaching the centre. Costae 3-3.5 in 10 μ, radial, alternating with 3-4 rows of alveoli, rarely 5, rows of alveoli 12-13 in 10 μ.

Hustedt's *E. zebra* v. *porcellus* (Kütz.) Grun. (Hustedt, Bacil. 385, f. 731) is treated as *E. zebra* v. *proboscidea* (Kütz.) Grun., by Cleve-Euler, since its ends are neither strongly constricted-capitate nor backwardly bent.

37. **Rhopalodia gibba** (Ehr.) O. Müll. (Fig. 47)

Hustedt, Bacil. 390, f. 740; Cleve-Euler, A., Diat. Schwed. Finn.—V : 44, fig. 1416 a, e (=*R. gibba* v. *genuina* Grun.); Van Heurck, Treat. Diat. 296, t. 9, f. 352 (=*Epithemia gibba* Kütz.).

Frustules free or found epiphytic on *Chara* and *Ceratophyllum*, 80-124 μ long and 18-20 μ broad, elongated, linear with slightly notched inflations in the middle ; ends subtruncate, slightly swollen with rounded corners. Valves 7-9 μ broad, dorsal side slightly bulged in the middle with a notch, ventral side straight with a slight depression at the ends which are acutely rounded. Costae 6-7 in 10 μ, becoming strongly radial towards the ends, alternating with 2-3 rows of alveoli, rows of alveoli 12-14 in 10 μ, fine but distinct, crossed by a hazy longitudinal band or fold.

This specimen agrees very well with illustrations given by Cleve-Euler and Van Heurck, but differs from that of Hustedt's which shows ends to be gradually narrowed in girdle view, as in *R. gibba* v. *ventricosa* (Ehr.) Grun. (Hustedt, Bacil. 391, f. 741 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 44, f. 1416 c-d).

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38. **Hantzschia amphioxys** (Ehr.) Grun. v. **densestriata** (Font.) A. Cl. (Fig. 48)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 49, f. 1419 n-p.

Valves 35-38 μ long and 5-5.5 μ broad, slightly arcuate, linear with constricted, rostrate obtuse ends. Keel excentric with keel puncta 9-10 in 10 μ, distinct. Striae 23-24 in 10 μ, fine but distinct.

39. **Nitzschia tryblionella** Hantz. v. **levidensis** (W. Sm.) Grun. (Fig. 16)

Hustedt, Bacil. 399, f. 760 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 51, f. 1430 i-l.

Valves 31-50 μ long and 8.7-10.5 μ broad, linear with constricted, slightly produced ends. Keel excentric, notched in the middle, keel puncta 10-11 in 10 μ. Striae 11-13 in 10 μ, coarse and undulate.

40. **Nitzschia thermalis** Kütz. v. **minor** Hilse (Fig. 49)

Hustedt, Bacil. 403, f. 772 ; Cleve-Euler, A., Diat. Schwed. Finn.—V. 6, 4f. 1445 g-h.

Valves 30-35 μ long and 7-7.5 μ broad, linear, concave in the middle with wedge-shaped, constricted rostrate ends. Keel excentric, keel puncta 10-12 in 10 μ. Striae over 30 in 10 μ, fine and seen with difficulty.

41. **Nitzschia commutata** Grun. v. **pamirensis** (Hust.) A. Cl. (Fig. 50)

Cleve-Euler, A. Diat. Schwed. Finn.—V : 64, f. 1443 c.

Valves 45-47 μ long and 7.7 μ broad, linear, concave in the middle with wedge-shaped, constricted, shortly capitate ends. Keel excentric, keel puncta 8-9 in 10 μ, distinct. Striae about 24 in 10 μ, fine.

42. **Nitzschia gandersheimiensis** Krasske (Fig. 51)

Hustedt, Bacil. 417, f. 804 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 86, f. 1495 b.

Valves 46-63 μ long and 3.4-4.4 μ broad, narrowly linear-lanceolate or lanceolate with somewhat constricted, produced rounded ends. Keel excentric, keel puncta distinct, somewhat irregularly disposed, 8-11 in 10 μ. Striae very fine, indistinct probably over 35 in 10 μ.

In the following table, in addition to the above named diatoms, others are also included which occurred in the said area. Since these are being described and illustrated from other places by the author and as they do not show any special feature of interest, it is therefore considered sufficient merely to list them and indicate their distribution in this region and other places in India.

TABLE SHOWING THE DISTRIBUTION OF DIATOMS COLLECTED FROM KOLHAPUR AND ITS IMMEDIATE VICINITY

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author[1]
Achnanthes minutissima Kütz. ..	Rankala, Kalamba, and other tanks; common.	17, 28.
Amphora ovalis Kütz. v. *pediculus* Kütz. ..	Widely distributed in pools and tanks; frequent.	5, 16, 19.
A. veneta (Kütz.) Hustedt	Widely distributed; very common.	17, 18, 28, 43.
Anomoeoneis sphaerophora (Kütz.) Pfit. ..	Rankala and Kalamba tanks and pools; occasional.	1, 5, 23, 42.
Caloneis silicula (Ehr.) Cl.	Rankala and Kalamba tanks; not common.	16, 17.
Cocconeis placentula Ehr.	do.	1, 5, 14, 23, 33, 46.
C. — v. *euglypta* (Ehr.) Cl. ..	Widely distributed; very common.	1, 16, 17, 19, 22, 42.
Cyclotella meneghiniana Kütz. ..	Widely distributed, particularly in slimy matrix; frequent.	1, 5, 16, 17, 19, 22, 39, 42.
C. — f. *binotata* Grun. ..	Rankala tank, pools, and filter-house drainage; rare.	17, 18.

[1] Numbers in this column refer to the bibliography at the end of this paper.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
Cymbella kerkevarensis A. Cl. ..	Pools, puddles, and tanks; not common. Also collected from Sagar and Jog Falls.	A new record for India.
C. tumidula Grun. ..	Rankala tank; rare.	do.
C. turgida (Gerg.) Cl. ..	Pools, puddles, and tanks; frequent but never abundant.	5, 16, 17, 21, 25, 42.
C. ventricosa Kütz. ..	Pools, puddles, and tanks; common.	4, 5, 16, 17, 28.
Diploneis puella (Schum.) Cl. ..	Stagnant water of drainage, pools, and puddles; not common.	1, 21, 28, 34, 39.
Epithemia zebra (Ehr.) Kütz. ..	Widely distributed in tanks; common.	1, 4, 5, 27.
E. — v. *frickei* A. Cl. ..	Rankala tank; occasional.	A new record for India.
E. — v. *porcellus* (Kütz.) Grun. ..	Rankala tank; common.	do.
E. — v. *proboscidea* (Kütz.) Grun. ..	Rankala tank; not common. Also in Kalamba tank.	do.
Eunotia lunaris (Ehr.) Grun. ..	Marginal slime of tanks; occasional.	1, 4, 5, 12, 23, 28, 47.
E. major (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg ..	Rankala and Kalamba tanks and puddles; not common.	5, 25 (= *E. indica* Grun.).
Fragilaria intermedia Grun.	Pools, puddles, and tanks; common.	21, 22, 42.
F. rumpens (Kütz.) Carl. v. *familiaris* (Kütz.) A. Cl. ..	Rankala, Kalamba, and other tanks; common.	22 (= *Synedra rumpens* v. *familiaris* Kütz.).
Gomphonema augur Ehr. ..	Pools and tanks; not common.	5, 17, 43.
G. gracile Ehr. ..	Pools, tanks, and ditches; common.	5, 6, 14, 15, 21, 28, 33, 46.
G. intricatum Kütz. ..	Rankala and Kalamba tanks; rare.	1, 5, 28, 33, 47.
G. — v. *bohemicum* (Reich. & Fricke) A.Cl. ..	Rankala tank and paddy fields; not common.	A new record for India.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
G. lacus-rankala sp. nov. ..	Rankala tank; common.	A new record.
G. — v. *gracilis* v. nov. ..	Rankala tank; rare.	do.
G. — v. *robusta* v. nov. ..	Rankala tank; less common.	do.
G. montanum Schum. v. *acuminatum* May. ..	Rankala tank and pools; not common.	17.
G. olivaceum (Lyng.) Kütz.	Rankala and temple tanks, and paddy fields; fairly common.	4, 5, 28.
G. parvulum (Kütz.) Grun.	Widely distributed; common.	5, 16, 17, 21, 25, 34, 42.
G. sphaerophorum Ehr. ..	Rankala and Kalamba tanks, pools; fairly common.	21, 28.
G. spicula sp. nov. ..	do. Also recorded from Bombay.	A new record.
G. subapicatum Fritsch & Rich. ..	Tanks, ponds, pools; common	1, 5, 17.
Hantzschia amphioxys (Ehr.) Grun. v. *densestriata* (Font.) A. Cl. ..	Rankala tank and pools; rare.	A new record for India.
Mastogloia recta Hustedt	Rankala tank; occasional.	do.
M. — v. *pulchella* Voigt ..	Rankala tank; common. Also recorded from Ahmedabad.	do.
Melosira granulata (Ehr.) Ralfs ..	Marginal slime of tanks, pools, ponds, and filter-house drainage pools; very common.	5, 6, 17, 19, 22, 46.
M. — v. *angustissima* O. Müll. ..	Rankala and Kalamba tanks, filter-house drainage; rare.	42.
M. — v. *muzzanensis* Meister ..	Rankala and Kalamba tanks, filter-house drainage fairly common.	22
Navicula cryptocephala Kütz. ..	Widely distributed ; common.	5, 12, 16, 24, 25, 47.
N. — v. *subsalina* Hust...	Rankala and Kalamba tanks and some pools ; not common.	17.
N. — *cuspidata* Kütz. ..	Pools, ponds, and tanks ; less common.	1, 5, 24, 46, 47.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
N. — *f. brevirostrata* f. nov. ..	Rankala tank; occasional. Also recorded from Lonavla.	A new record.
N. — v. *ambigua* (Ehr.) Cl.	Widely distributed; common.	16, 24, 46, 47.
N. — v. *conspicua* Venkat.	Tanks and ponds; not common.	17, 24, 42.
N. minuta (Cleve). A. Cl.	Rankala tank; rare.	A new record for India.
N. mutica Kütz. ..	Desiccated soils, marginal slime of tanks; common.	5, 18, 46, 47.
N. pupula Kütz. ..	Rankala and Kalamba tanks, and pools; common.	5, 19, 24, 46.
N. — v. *capitata* Hust. ..	Rankala and Kalamba tanks, and pools; fairly common.	16, 24, 43.
N. — v. *elliptica* Hust. ..	Rankala and Kalamba tanks, and pools; not common.	17.
N. pygmaea Kütz. ..	Rankala and Kalamba tanks; fairly common.	24, 42.
N. radiosa Kütz. ..	Pools and puddles, tanks; not common.	1, 5, 43.
Nitzchia amphibia Grun.	Widely distributed; common.	5, 6, 16, 17, 34, 42.
N. — v. *acutiuscula* Grun.	Small drying pools and ponds; less common.	17.
N. commutata Grun. v. *pamirensis* (Hust.) A. Cl.	Rankala and Kalamba tanks; not common.	A new record for India.
N. frustulum (Kütz.) Grun.	Wet soils, pond, pools, and puddles; fairly common.	16.
N. gandersheimiensis Krasske ..	Rankala and Kalamba tanks, and ponds; not common.	16.
N. obtusa W. Sm. v. *scalpelliformis* Grun. ..	Widely distributed; common.	16, 17, 34, 42.
N. palea (Kütz.) W. Sm. ..	Widely distributed, also in wet soils; very common.	1, 5, 17, 18, 34, 42.
N. thermalis Kütz. v. *minor* Hilse ..	Marginal slime of tanks, wet soils; fairly common.	18.
N. sublinearis Hust. ..	Pools and tanks; common.	16, 17.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
N. tryblionella Hantz. v. *levidensis* (W. Sm.) Grun.	Pools and tanks; not quite common.	16, 42.
Pinnularia acrosphaeria Brèb. ..	Rankala, Kalamba, and other tanks; frequent.	5, 6, 19, 20, 21, 33, 42.
P. — v. *minor* Cleve ..	Widely distributed in ponds and tanks; never abundant.	17, 19, 20.
P. biceps Greg. v. *amphicephala* (May.) A. Cl. ..	Pools and tanks; not common.	A new record for India.
P. notata (Perag. & Hèr.) A. Cl. v. *rostrata* A. Cl.	Rankala tank; rare.	do.
P. kolhapurensis sp. nov. ..	Rankala tank; rare.	A new record.
Rhopalodia gibba (Ehr.) O. Müll. ..	Kalamba and Rankala tanks and some ponds; less common.	1, 4, 5, 17, 42.
R. gibba v. *ventricosa* (Ehr.) Grun. ..	Widely distributed; more frequent than the above type.	17, 42.
Stauroneis phoenicenteron Ehr. ..	Tanks, ponds, and puddles; fairly common.	5, 6, 21, 23, 27, 31, 34, 46, 47.
Surirella tenera Greg. ..	Kalamba tank; rare.	19, 42.
Synedra acus Kütz. ..	Pools and tanks; common.	5, 6, 17, 28, 47.
S. ulna (Nitz.) Ehr. ..	Widely distributed; very common.	1, 4, 5, 16, 19, 21, 22, 42.
S. — v. *amphirhynchus* (Ehr.) Grun. ..	Widely distributed; frequent.	1, 5, 16, 17, 19, 22, 47.
S. — v. *biceps* Kütz. ..	Rankala and Kalamba tanks; occasional.	19.
S. — v. *danica* (Kütz.) Grun. ..	Tanks, ponds, and pools; fairly common.	16, 19, 21, 22.
S. — v. *subaequalis* Grun.	Rankala and Kalamba tanks; not common.	22, 33, 46.

SUMMARY

For the first time the freshwater Diatomaceae of Kolhapur and its immediate environs are investigated. Of these an illustrated account is presented in these pages. In a separate table the distribution of forms is given indicating the places of collection in Kolhapur, previous places of collection in India and their authors, and new records for science as well as for India.

In all seventy-nine diatoms are recorded from the said area, of which thirteen are new records for India, and three species, two varieties, and one form considered to be new.

ACKNOWLEDGEMENT

The author wishes to express his grateful thanks to Rev. Fr. Francis Braganza, S. J., of St. Xavier's College, Ahmedabad, for correcting the Latin diagnoses; and to Profs. J. B. Petersen, A°. Berg, Foged Niels, J. W. G. Lund, Dr. Hustedt, Mr. M. Voigt, and other friends for providing the literature.

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On the Occurrence of the Eel *Neenchelys buitendijki* Weber & de Beaufort in Indian Waters[1]

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(*With one plate*)

While examining a collection of eels from Sassoon Dock—the principal fish landing place of Bombay City—a few specimens of *Neenchelys buitendijki* Weber & de Beaufort were obtained in April 1953. The species not having been recorded from India so far, regular searches were made in the subsequent fish catches for further material and relevant data regarding its occurrence. It was revealed that the species is not rare in this locality, and a large number of specimens was obtained. Since the original description of this eel (Weber & de Beaufort, 1916) was based on only two specimens it is thought desirable to describe the species in greater detail in the light of the present good series:

GENUS *Neenchelys* BAMBER

Gill openings separate, lateral. Distance from anus to gill opening much more than length of head. Body scaleless. Caudal confluent with anal and dorsal. Nostrils lateral. Pectorals present. Anus in anterior half of length. Tongue not free. Teeth acute, uniserial. Branchial openings in pharynx narrow slits. Intermaxillary plate pointed.

KEY TO THE SPECIES OF *Neenchelys* BAMBER

i. Origin of dorsal fin as far from gill opening as latter is from angle of mouth. Pectorals shorter than snout. ... *N. microtretus*
ii. Origin of dorsal fin not as far from gill opening as latter is from angle of mouth. Pectorals longer than snout. ... *N. buitendijki*

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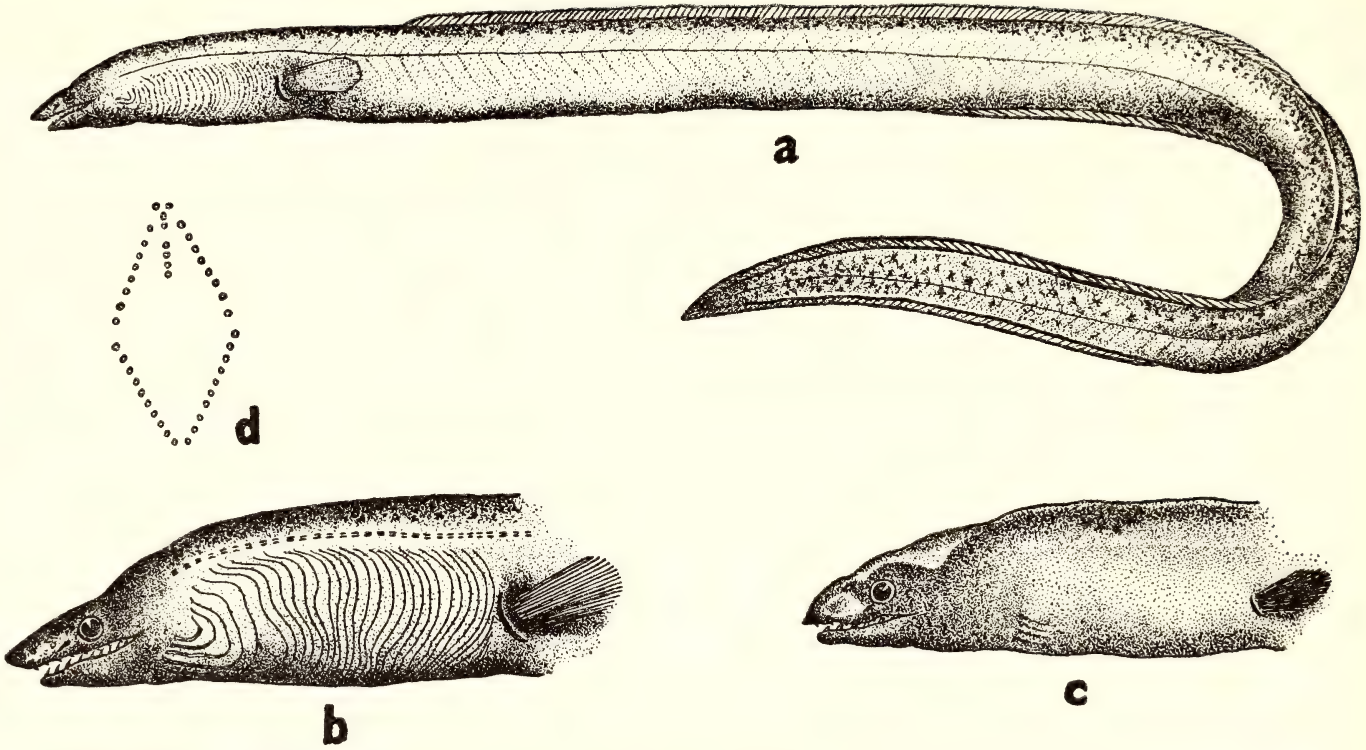

a. *Neenchelys buitendijki* Weber & de Beaufort x 1 ; b. Head of *N. buitendijki* x 2 ; c. Head of newly metamorphosed elver of *N. buitendijki* x 8 ; d. diagrammatic representation of the arrangement of teeth in *N. buitendijki*.

Neenchelys Buitendijki Weber & de Beaufort

Description: D. 335-346; A. 225-228; C. 9; P. 14-16; B. 31-36. Head 7.6 to 8.5 in total length and more than two in trunk. Height 19.8 to 24.6 in total length and 2.3 to 3.6 in length of head. Snout 6.5 to 7.3 in head length. Head and body 1.2 to 1.6 in length of tail and 2.3 to 2.7 in total length. Diameter of eye 19.3 to 25.5 in head and 3 to 3.4 in snout.

The body proportions generally agree with the description of Weber and de Beaufort (1916) but since a large number of specimens have been examined during the present study the range in variation has shown some increase. The detailed precision measurements made from fifteen specimens are given in Table I.

The body is scaleless, sub-cylindrical and posteriorly compressed. The head is conical and pointed and the eyes are very small without eyelids. The snout is conical and somewhat prominent due to the intermaxillary plate being produced forward into a sharp point. The anterior nostril is in the form of a small opening just behind the tip of the snout. A small flap of skin, present on either side of this opening, gives it an apparently tubulate appearance. The posterior nostril is a small, elongated, slit-like opening in front of the eye, more or less on a level with its lower half. A few mucilage pores are present on the nape and snout. The cleft of the mouth reaches far behind the orbit, for a distance equal to more than one diameter of the eye. The mouth is inferior, the lower jaw being smaller than the upper. The throat is silvery and the characteristic arrangement of the branchiostegals can be seen externally in the fresh condition (Plate, fig. *b*). Specimens stained in alizarin revealed 31 to 36 branchiostegals on each side, whereas Weber and de Beaufort (1916) have observed only 25. Teeth in the jaws are uniserial, acute, long and widely set in a slanting backward direction. The number of teeth in the jaws is variable, but generally number 8 on the maxillaries and 10 on the mandibles (Plate, fig. *d*). There are four teeth on the intermaxillary plate and an equal number on the vomer. On the anterior end of the intermaxillary plate two teeth are arranged side by side while all the others including those on the vomer are placed in a series one after the other. The tip of the intermaxillary plate is pointed and often appears as a horizontally directed median tooth. All the four teeth on the intermaxillary plate are depressible and can be considered as homologous with the mesial teeth of the genera *Muraena, Gymnothorax,* etc. The teeth on the front part of the

TABLE I

Precision measurements made on 15 specimens of *Neenchelys buitendijki* Weber & de Beaufort

(Recorded in thousandths of the total length)

Serial No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total length in mm.	58.5	66.0	79	92	115	117	122	128	149	155	158	161	179	222	273
Head	126	121	123	119	126	120	123	125	123	125	120	125	127	117	117
Height	32	31	42	41	41	43	43	45	42	46	51	48	50	47	46
Snout	17	18	18	8	17	17	18	18	17	15	18	18	19	18	15
Eye	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
Preanal distance	357	369	367	380	383	393	418	429	409	419	402	416	435	428	407
Predorsal distance	167	167	177	173	165	154	164	169	172	180	168	179	190	167	170
Tail	643	631	633	620	617	607	582	571	591	581	598	584	565	572	593

jaws are longer than those on the posterior part. Those on the vomer and the intermaxillary are large.

Lateral line commences from a little distance behind the eye, the distance being more or less equal to the length of snout. It continues in the form of a straight line in the dorso-lateral aspect of the body. This line generally appears to be a dotted line because of the presence of numerous ossified subcutaneous tubes wherein the sensory nerves end. These bony elements are seen to take stain very readily when specimens are treated with alizarin.

The vertical fins are low and are supported by unbranched rays. The pectoral fins are longer than the snout and they originate from close behind the gill openings. Branched fin-rays support these fins. The caudal is continuous with the dorsal and the anal fins. The origin of the dorsal fin is more than half as far from the gill opening as the latter is from the angle of the mouth. The anal fin originates from close behind the vent.

In the fresh condition, the fish is yellowish pink in colour. The portion of the body above the lateral line is pigmented with closely distributed, brown, branching chromatophores. In the tail region the pigmentation is more intense and uniform. The fins are generally whitish in colour and are unpigmented, but the posterior end of the dorsal and anal fins, as well as the whole of the caudal fin are black in colour due to intense pigmentation.

The size of the specimens in the collection varied from 58.5 mm. to 273 mm. in total length; the one which is 273 mm. is the largest known so far as the previous record was only 218 mm. (Weber and Beaufort). The number of vertebrae generally varies from 145 to 148 of which 53 are preanal.

OCCURRENCE

N. buitendijki is found to occur in fair numbers among the shrimp catches landed at Sassoon Dock and Versova—the two fish landing places of Bombay City. They are generally caught in 'Dol' nets (bag nets used with the help of stakes or buoys) from depths varying from 8 to 10 fathoms. Although there are no data regarding its quantitative occurrence during any particular season, it appears more frequently in the catches from December to May, during which period the majority of the present collection was obtained.

DISTRIBUTION

Bamber (1915) first created the family Neenchelidae to include a single specimen she had collected from the Sudanese Red Sea.

This specimen had been named by her as *Neenchelys microtretus.* There appears to be no further record of this species from anywhere. Weber and de Beaufort (1916) added another species (*N. buitendijki*) to this family based on only two specimens; one—the type 218 mm. long in Amsterdam Museum—probably from the Moluccas and the other, 129 mm., collected by Mr. Buitendijk from Java. Hardenberg (1931) noted this species as occurring 'very rarely' in the Rokan River mouth, off Sumatra, but added no further comment on the species. The present record extends the distribution of *N. buitendijki* to the west Coast of India (Bombay) where it is fairly common.

BIOLOGICAL NOTES

The fact that the species was obtained from the 'Dol' net catches indicates that it is a bottom-living form. Specimens above 160 mm. were found to possess mature or maturing gonads. About 20 specimens were examined for stomach contents and it was found that the majority of the stomachs were gorged with polychaets while the others were empty.

The smaller specimens in the collection seem to be newly metamorphosed elvers of the species. In the smallest, which is 58.5 mm. long, the head is more conical and the upper profile less convex (fig. *c*). The olfactory pit still exists in the form of a depression and the contour of the brain is fairly evident. The full complement of the adult set of teeth is not seen at this stage, there being only 6 on the upper and 7 on the lower jaw. The tip of the intermaxillary plate projects out in the form of a large median tooth. In the throat region four branchiostegal rays are discernible. The pigmentation of the head is very feeble and consists of only one group of brown, branching chromatophores on the nape. In the body the most striking pigmentation is a few (generally 8-9) large pigment cells distributed at regular intervals along the lower portion of the lateral line. The brown pigment cells on the upper part of the body, which are so characteristic of the adults, have just begun to appear very faintly and the body is more or less transparent in the fresh condition. The position of the anus is slightly ahead of that of the adult (vide table I). It is seen from the measurements of the pre-anal distance and the tail that the position of the anus gradually shifts backwards as the fish increases in length. The diameter of the eye is greater in the smaller individuals.

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Identity of the plant *Piyaman* or *Madar-jamua*

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AND

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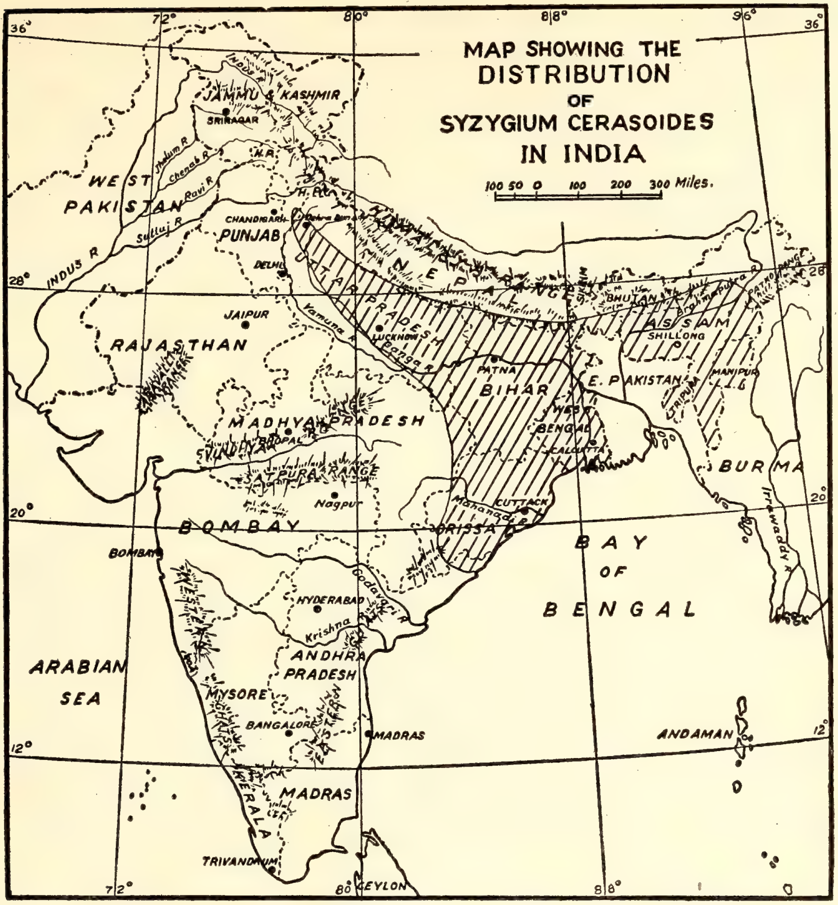
(*With one map and one plate*)

Forest officers and field botanists who are familiar with the *sal* forests of India have, no doubt, seen a tree commonly called *piyaman, madar-jamua, rai-jamua, boti-jamb,* and *dugdugiya.* The plant was hitherto commonly known as *Eugenia operculata* Roxb., and the species is frequently met with in grassland near such forests and grassy open spaces, where it occurs as a pioneer tree and a nurse to young *sal* plants. Its leaves usually turn bright red in winter before leaf-fall and, during the cold season, make a characteristic feature of the landscape. From the silvicultural point of view the species is therefore important as it serves as a nurse to *sal* (*Shorea robusta* Gaertn. f.) and helps its regeneration. Although the plant is known to forest officers and others, it was found that there is considerable confusion regarding its correct botanical identity. It is proposed here to clarify and establish the correct identity of the plant.

The species is distributed in the sub-Himalayan region from Uttar Pradesh to Assam, and is also found in Parasnath, Singbhum, Mayurbhanj, and Agartala. Outside India, it is found in upper and lower Burma and Chittagong (E. Pakistan). According to some authors the species has a wider distribution in south-east Asia including Borneo, the Philippines, and Australia. The accompanying map shows the distribution of this species in India.

Merrill and Perry (*J. Arn.* **18**: 322-343; 1934) in their series of papers on the revision of the genus *Eugenia* have preferred to isolate species with calyptrate calyx, which falls off with the petals, into the genus *Cleistocalyx.* In doing so, they accepted the earlier view of Blume who established the genus in his Mus. Bot. Lugd.-Bat. **1**: 84; 1840. Merrill and Perry transferred *Eugenia operculata* Roxb. to *Cleistocalyx operculata* (Roxb.) Merrill & Perry, but they unfortunately combined our broad-leaved plant with a narrow-leaved


MAP SHOWING THE
DISTRIBUTION
OF
SYZYGIUM CERASOIDES
IN INDIA
100 50 0 100 200 300 Miles.
36°
72°
80°
88°
96°
28°
20°
12°
JAMMU & KASHMIR
SRINAGAR
WEST PAKISTAN
Jhelum R
Chenab R
Ravi R
Sutluj R
INDUS R
H.P.
CHANDIGARH
PUNJAB
DELHI
UTTAR PRADESH
LUCKNOW
Yamuna R
Ganga R
NEPAL
BHUTAN
ASSAM
SHILLONG
Brahmaputra R
MANIPUR
TRIPURA
JAIPUR
RAJASTHAN
MADHYA PRADESH
BHOPAL
VINDHYA RG
SATPURA RANGE
Nagpur
PATNA
BIHAR
WEST BENGAL
CALCUTTA
E. PAKISTAN
BURMA
Irrawaddy R
BOMBAY
ORISSA
CUTTACK
Mahanadi R
BAY OF BENGAL
HYDERABAD
Godavari R
Krishna R
ANDHRA PRADESH
ARABIAN SEA
MYSORE
BANGALORE
MADRAS
KERALA
TRIVANDRUM
CEYLON
ANDAMAN

calyptrate calyxed form. Their reasons for considering the large-leaved form under this species was that they could not find any constant characters in the apparently inadequate material which they examined. They have, however, stated: 'Of all the known species of the genus *Cleistocalyx*, this is the commonest, the most widely distributed, and perhaps the most misinterpreted.' This statement is significant, because one of the authors (P.C.K.), who examined a number of fresh flowers of the broad-leaved plant commonly known as *piyaman*, found to his surprise that it has larger flowers and *non-calyptrate* calyx and is therefore different from *Cleistocalyx* proper. This fact has led us to believe that *Eugenia operculata* as understood by Duthie and described in Hooker's FLORA OF BRITISH INDIA 2: 498 (1879) is a mixture of two or more species, of which at least one is *Cleistocalyx operculata* and the other is our broad-leaved non-calyptrate species.

Our plant, i.e. the broad-leaved form, has the following characters:

Leaves elliptic, suborbicular, or obovate, 9-21 cm. long, 6-13 cm. broad, with broad apex and short or no acumen, glandular, pellucid.

Calyx not calyptrate; sepals small, subacute to broadly obtuse, distinct, deciduous.

Corolla pseudo-calyptrate, i.e. falling off in one piece, but the petals easily separable.

It will be evident therefore that this plant is a true *Syzygium* and not a *Cleistocalyx*. It is therefore necessary to find a suitable name for this plant under *Syzygium* and separate it from *Cleistocalyx operculata* proper. Henderson (1949) however does not agree to treat the latter species under *Cleistocalyx* and calls it by its older name *Eugenia operculata* Roxb.

The earliest name for our broad-leaved form appears to be *Syzygium nervosum* DC. (Prod. 3: 260; 1828). Unfortunately, this name being a later homonym of *Syzygium nervosum* Lour. (Fl. Cochinchin. 308; 1790) becomes invalid under the rules of botanical nomenclature. Loureiro's plant is different from that of De Candolle. We are thus left with the next validly published name of Roxburgh, i.e. *Eugenia cerasoides*, which was described in 1832. The leaves are 9-21 cm. long and 4-8 cm. wide, usually oblong-lanceolate or elliptic-lanceolate to oblanceolate, with acuminate or bluntly short acute apex. This name is used as basonym for a new combination under *Syzygium*. The correct name and synonyms of the species are as follows:

Syzygium cerasoides (Roxb.) Chatterjee et Kanjilal f. *comb. nov.*

Eugenia cerasoides Roxb. Fl. Ind. 2: 488; 1832; Miq. Fl. Ind. Bat. 1: 443; 1855.

Syzygium nervosum DC. Prod. 3: 260; 1828 (*non* Lour.); Wall. in Wall. Cat. no. 3551 and 3551 B.

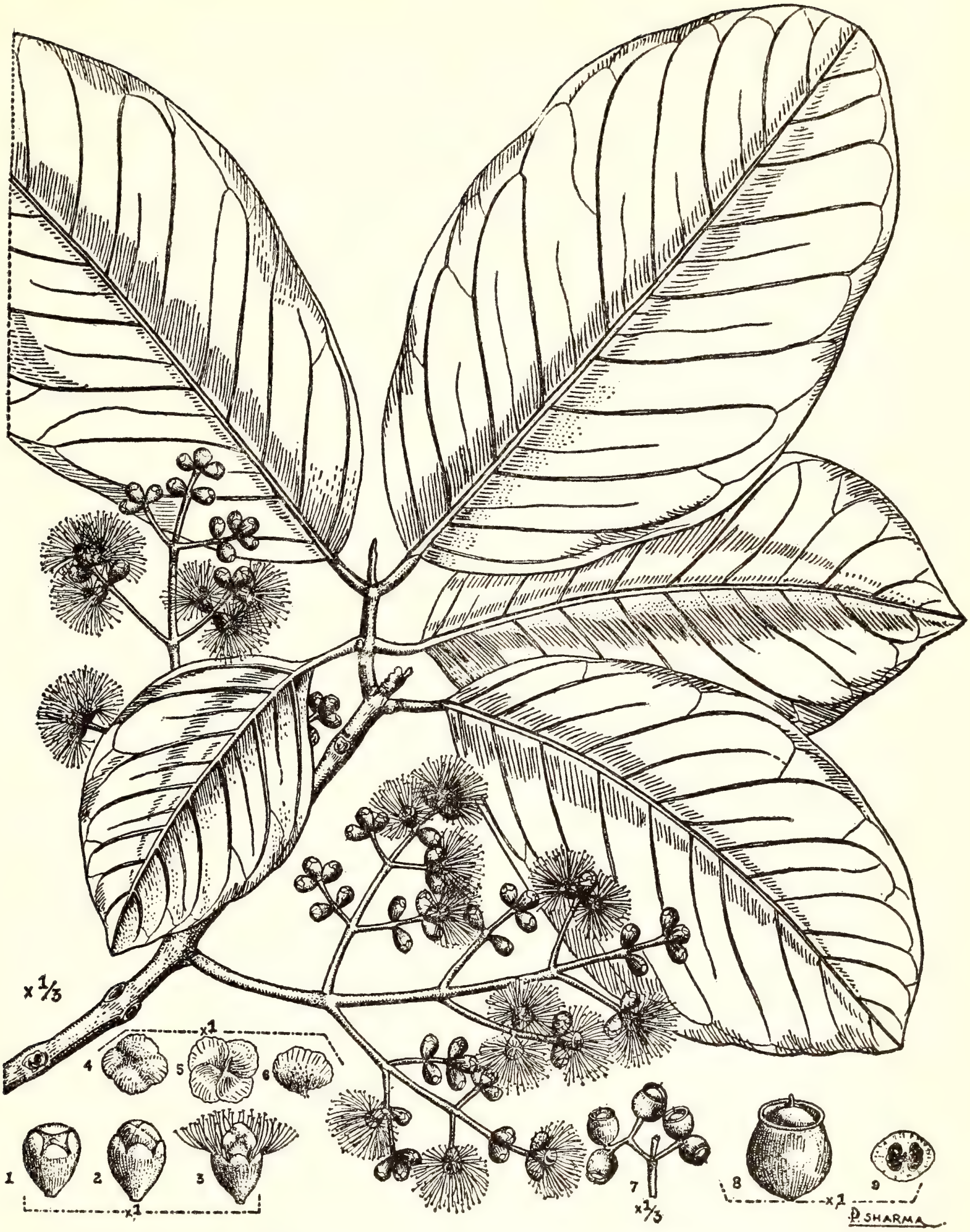
Eugenia operculata var. *obovata* Kurz, For. Fl. 1: 482; 1877.

Eugenia operculata Roxb. Duthie in Hooker's Fl. Br. Ind. 2: 498; 1879.

Eugenia operculata Roxb. var. *genuina* Koorders and Valeton, Bijdr. 6: 151; 1900.

Syzygium operculatum Neidnz. in Engl. and Prantl, Pflanzenfam. 3 (7): 85; 1898.

Note: We are not very sure what specimens Niedenzu had when he made the combination. It is perhaps probable that he had the broad-leaved form before him.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P. SHARMA

Syzygium cerasoides Chatterjee & Kanjilal

1. Flower bud; 2. Flower before anthesis; 3. Flower at anthesis, showing separation of the 'pseudo-calyptrate corolla'; 4. Corolla viewed from above; 5. Corolla seen on inner side; 6. Separated petal; 7. Fruits; 8. Fruit; 9. Cross section of ovary.

DISTRIBUTION

UTTAR PRADESH: Saharanpur, *McGallan* without number, dated 11th June 1903; Dehra Dun, *P.W. Mackinnon* without number, May 1898; Gurhwal, Herb. *Falconer* 484; Gonda, *Harsukh* 21678; Gorakhpur, Madholia range, *Shri Ram* 1043 dated 14th May 1916; Bahraich Dist., Bhachkai forest, *Shri Ram* 2561 B dated 29th May 1920; Pilibhit, *Inayat* 21675 dated 5th June 1898; Pilibhit, *Nawadia, G.R.* 1038 b dated 19th May 1914; Gonda, Bhamar range, *Tara Dutt* without number dated 23rd May 1922.

BIHAR AND ORISSA: Singbhum, Haines 148; Parasnath without name of collector dated 14th November 1858; Mayurbhanj, *D. Hooper* 38816 dated 29th June 1912; Cultivated Hort. Bot. Calc. Wall. Cat. 3551.

ASSAM: Singra, *A. C. Chatterjee* without number, 1902; Shakhati, Dhubdhara Hill, *A. C. Chatterjee* without number, 1902.

TIPPERAH: *Debbarman* 766 and 1228.

E. PAKISTAN: Chittagong hill tracts, *Kings collector* 372. (All specimens cited above are from the Calcutta Herbarium.)

The major collection of Roxburgh's specimens is lodged at the Botanic Garden at Brussels. This collection was examined by Merrill and a list of available species prepared in 1952. Unfortunately, the name *Eugenia cerasoides* Roxb. does not occur in this list (a copy of which is available at the Calcutta Herbarium), and therefore it may be concluded that there is no type specimen of this species existing at present. In the absence of any authentic material this species has to be typified by Wight's Icones tab. 615 (1843), which agrees very well with our species except for the drawing of the fruit which shows persistent sepals—a character not recorded by any other author. Wight has also correctly recorded the nature of petals and said that the species 'is distinguished by its free expanding petals—a character not noticed by Roxburgh'. This would indicate that he also noticed the petals which separate from each other before they fall. As a matter of fact the petals are imbricate. Miquel's description of the species also mentions the basically free nature of the calyx segments. Shri Ram's sheet no. 1043 mentioned above may be considered as a good lectotype.

ACKNOWLEDGEMENTS

We are deeply indebted to Sri M. B. Raizada, Head of the Division of Forest Botany, Forest Research Institute, Dehra Dun, for his valuable help and criticism during the preparation of this note. Our thanks are also due to Dr. S. K. Mukerjee, Keeper of the Central National Herbarium, Indian Botanic Garden, Calcutta, for his help in connection with the present investigation, to Sri S. K. Seth, Silviculturist, Forest Research Institute, for some very useful photographs and for the map, and to the staff of the Botany Branch of the Institute for ungrudging assistance.

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Remarks on Indian Cyprinid Fishes described by Jerdon (1849) under *Gonorhynchus* McClelland

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(*With a plate*)

INTRODUCTION

The fish survey of the Cauvery River and its tributary streams undertaken by me during March-April 1951, May 1953, and October 1954 has facilitated the clarification of the nomenclatorial status of many of the species described by Jerdon in his treatise on the 'Freshwater Fishes of Southern India', published in 1849. The bulk of his material came from the Cauvery watershed and he described a number of new species, the status or systematic position of many of which has hitherto remained uncertain. In the following pages, I have attempted to codify the nomenclature of three species described by Jerdon under the name *Gonorhynchus* McClelland (*nec* Gronow 1763 and Scopoli 1777). The species referred to are :

1. *Gonorhynchus gotyla* Gray
2. *Gonorhynchus McLellandi* Jerdon (New species)
3. *Gonorhynchus stenorhynchus* Jerdon (New species)

The three species are at present referable to the genus *Garra* Hamilton, of which it may be noted that the most up-to-date revision is that carried out by Hora (1921). Among the ichthyologists who have commented on Jerdon's species, mention must be made of Günther (1868), Day (1867, 1877), Annandale (1919), and Rao (1920). There has been no uniformity in the treatment accorded to Jerdon's above-mentioned species in earlier works, for some have considered all three as nominal species, while others have recognised one (*G. stenorhynchus*) as valid. This confusion seems to have been due to the few specimens that were available to them for study. My own collections and the examination of previous collections of *Garra* from the Cauvery system clearly show that three distinct species-groups can be recognised from this watershed, each exhibiting minor variations in the different tributary streams, a close study of which it is possible will eventually help in differentiating the different stream populations even into subspecies.

However, such detailed scrutiny does not come within the scope of the present paper.

SYSTEMATIC POSITION OF *Gonorhynchus Gotyla* JERDON (nec GRAY)

(Plate, fig. C)

The description of *Gonorhynchus gotyla* given by Jerdon is brief; but comparison of the typical specimens of *Garra gotyla* Gray in the fish collection of the Zoological Survey of India (from north-eastern India) with the specimens from the river Cauvery, at present referable to Jerdon's description of *Gon. gotyla*, shows marked differences in the shape of the snout, the disposition of the tubercles on the snout, and certain body proportions, on which grounds it is better to consider the two as distinct, a course which was rightly adopted by Hora and others.

Günther (1868) placed *Gonorhynchus gotyla* Jerdon (*nec* Gray) in the synonymy of the composite species *Discognathus lamta* (Hamilton). Day (1877) included it in the synonymy of both *Discognathus lamta* and *D. jerdonia* (Day), with no comments. Annandale (1919), who was the next to remark on the species, placed it in the synonymy of *D. jerdonia* (Day) of which species he observed that it is 'common in the Bhavani river near the base of the Nilgiris both before and after the stream leaves its gorge . . . . Jerdon found it in the Manantoddy as well as the Bhavani and Day records it from the Wynaad.' Rao (1920) made no mention of *Gonorhynchus gotyla* Jerdon (*nec* Gray), but described *Garra lamta* and a variety of *Garra jerdonia* Day, viz. var. *brevimentalis* Rao, from the headwaters of the river Cauvery in Mysore. Of these, I consider his *G. lamta* (in part) and the variety *brevimentalis* as representing *Gonorhynchus gotyla* of Jerdon. Hora (1921) placed *Gonorhynchus gotyla* Jerdon in the synonymy of *Garra stenorhynchus* (Jerdon).

In my opinion, the species of *Garra* commonest throughout the river Cauvery is the one which agrees in most of the characters with the description of *Gonorhynchus gotyla* Jerdon. In this form the lateral-line scales are almost always 34 or less than that (32 to 34 and exceptionally 35). In the scalation, fin ray counts, and body proportions it closely resembles *Chondrostoma mullya* Sykes from the Krishna watershed further north, which in turn seems to be closely related to the genotype *Garra lamta* Hamilton. Until more detailed comparisons are carried out these may be considered conspecific. Adult specimens of the typical *G. lamta* that I have examined (from Chota Nagpur, Gangetic watershed) are of a maximum size of 75 mm. in standard length, while the Cauvery specimens appear to be much larger attaining a maximum standard length of about 130 mm. or more and possessing a broader adhesive disc with a narrower velum. Thus we find that the *G. lamta* species-group has a more or less continuous distribution from north-eastern India through peninsular India to even Ceylon, where it is represented by another closely allied form *G. ceylonensis* Bleeker. The Cauvery specimens that I have compared with the specimens of *G. mullya* in my collection from the Poona area (type locality of *G. mullya*) do not show any noteworthy difference except that in the former the snout is more profusely covered with open mucous pores and horny tubercles. Until its consistency and significance are studied from considerably larger samples (for both males and females have pores and tubercles on the snout as in *G. stenorhynchus*, *G. gotyla*, *G. mcclellandi*, etc.), it will be possible to assign *Gonorhynchus gotyla* Jerdon (*nec* Gray) only to the synonymy of *Garra lamta* Hamilton. If the differences in the above-noted character or other meristic details prove significant enough for the recognition of distinct species or subspecies in the two watersheds, the availability of an already proposed name, *brevimentalis*, is indicated here to denote the specimens from the river Cauvery. No doubt, *G. lamta* in the Cauvery itself exhibits a certain diversity of characters, especially in the nature of the snout and the arrangement of the pores and tubercles, often showing intergradation with allied species and thus leading one to suspect inter-specific hybridization in nature between the species of *Garra* occurring there. During field collections I have obtained *G. lamta* along with either or both the species *G. stenorhynchus* and *G. mcclellandi*, and the specimens of the three species collected from the Cauvery River in April-June and October-November showed that the mature females were mostly gravid, which suggests that their breeding seasons probably coincide. This, in addition to the similar habits of life exhibited by these species makes possible the more common occurrence of interspecific hybrids between these species. It will be interesting if more detailed studies are made in the light of these observations.

A brief re-description of *G. lamta* from the Cauvery River is given here based on specimens collected from the Manantoddy River (Wynaad), the Cauvery River (Mysore), and the Bhavani and the Moyar Rivers (Nilgiris), all tributaries of the main Cauvery River :

D. ii-iii, 8 ; P. i, 12-13; V. i, 8 ; A. ii, 5 ; C. i, 17, i ; L- 1. 32-35 ; L. tr. 4-4½/1/2½-3 predorsal scales 10-11; circumpeduncular scales 16; scales between vent and anal origin 4-5 (The frequency distribution of the fin rays and scale counts are given on p. 530) ; anal fin when addressed reaching base of caudal fin ; snout without a proboscis ; mucous pores and horny tubercles present or absent on snout; tubercles when present arranged in more or less bilaterally symmetrical patches as follows: (1) antero-rostral patch at the tip of snout often in a continuous band, separated from the rest of the snout by a narrow deep furrow, (ii) postero-rostral patches, being two small laterally arranged patches in the middle of the snout behind the antero-rostral patch; (iii) antero-lateral patches, being lateral to the postero-rostral patches; (iv) inter-nasal patches, being two patches of tubercles situated behind the postero-rostral patches between the anterior nostrils; and (v) inter-naso-orbital patch, being situated between the posterior margin of the posterior nasal opening and the anterior margin of the orbit on either side. All or a few of these patches may be present. Colour : a distinct black shoulder spot behind upper angle of gill-opening; a mid-lateral dark band commencing from behind opercle, often very faint and diffuse and ending in a precaudal spot; latter generally indistinct in larger examples ; two or three dark longitudinal incomplete narrow bands above and below dark mid-lateral band separated by lighter interspaces, all being well-defined on the sides of the caudal peduncle ; abdomen and ventral side of body yellowish white; fins hyaline, the pectoral and lower caudal finrays being generally darker.

Garra malabarica Day (1865) and *Garra alta* Day (1867) from the Cauvery River are synonyms of *Garra lamta* as designated here.

Systematic Position of *Gonorhynchus McLellandi* Jerdon

(Plate, fig. D)

The second species, namely *Gonorhynchus McLellandi* Jerdon, has for long been considered a nominal species and some ichthyologists have completely ignored it. Jerdon's description of it is cited in full below :

> ' Snout covered with numerous pores ; profile rising to the dorsal, slightly concave from that to the tail—head is to the whole body as 1 to $4\frac{1}{2}$, height is $3\frac{2}{3}$ in its total length ; two longish cirri, head depressed in front, dorsal fin rather high. D. 10. A. 7, &c.—Colour dusky green above, golden on sides and greenish white beneath ; caudal fin green in centre, reddish above and below; other fins yellow, edged with red ; cheeks golden, 36 scales along the body in 9 rows. Length 10 inches.' (Jerdon, 1849, p. 310.)

The species was noted as occurring in the ' Bowany River ' at the foot of the Neilgherries and also in the ' Manantoddy River', both tributaries of the river Cauvery. I have collected the typical form of *Gonorhynchus mcclellandi*[1] from the Manantoddy River at Manantoddy (Wynaad) and find that Jerdon was wrong in characterising his species as having only two ' longish cirri ', for my specimens show two pairs of barbels—the long rostral pair which Jerdon seems to have noted and a very short and rudimentary pair of maxillary barbels which are situated in the labial groove at the place where the rostral fold joins the ' adhesive disc ' and is generally overlapped by the velum of the disc, thereby hiding it from view. *G. mcclellandi* is distinct from the remaining species of *Garra* occurring in the Cauvery River in a combination of characters, the most important being the comparatively more elongate and flattened body form, the distinctly conical or pointed snout, the characteristic number of about 36 lateral line scales (general range 35 to 37), and the position of the vent which is greatly removed from the origin of the anal fin. The frequency distribution of the fin rays and scale counts are given in the tables on p. 530. Mucous pores on the snout are present even in young specimens measuring about 2 inches, but one noteworthy feature is the almost complete absence of the large horny tubercles which are so characteristic of *G. stenorhynchus* and even *G. lamta* (from Cauvery River). My collections show that the combination of the specific characters given above is true of specimens of *G. mcclellandi* found throughout the Cauvery River. The only noteworthy difference in specimens from the different localities is the greater or lesser number of mucous pores present on the snout, but as this may be attributable to age and sex its taxonomic utility in this particular instance seems to be dubious. As for the colour of the species, the shoulder spot is present behind the upper angle of the gill-opening as in *G. lamta* and the dark mid-lateral band is well-defined in smaller specimens, while in larger examples it merges with the dark greyish colour of the upper half of the body. Incomplete dark narrow lateral bands above and below the mid-lateral band in the posterior half of the body (characteristic of *G. lamta* and *G. stenorhynchus*) are conspicuous by their absence. Almost the entire ventral half of the body is yellowish white (Plate, fig. D).

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[1] The name *McLellandi* is correctly spelt here as *mcclellandi.*

Thus with the re-discovery of *G. mcclellandi*, the following species described from the Cauvery River in Madras (*Garra platycephala* Rao) and those from the Bhavani River (*Garra jerdonia* Day and *Discognathus elegans* Annandale) do not seem tenable. None of these are specifically distinct, although Rao (op. cit.) gave the lateral line scale count in *G. platycephala* as 37 to 39, which seems to be an exceptionally high count. I have not come across such high counts in specimens from Mysore. Hora (1921) was right in considering *G. jerdoni* Day and *D. elegans* Annandale as conspecific, and both are considered here synonyms of *G. mcclellandi*. Thus, the following, it is felt, is the correct rendering of the synonymy *Garra mclellandi* (Jerdon):

Garra mcclellandi (Jerdon)

Gonorhynchus McLellandi Jerdon, *Madras J. Lit. and Sci.* **15,** p. 310 (1849). Type locality : Manantoddy River and the Bowany River, both tributaries of the Cauvery River.

Discognathus lamta Günther, (in part), Cat. Fish. Brit. Mus. 7, p. 69 (1868).

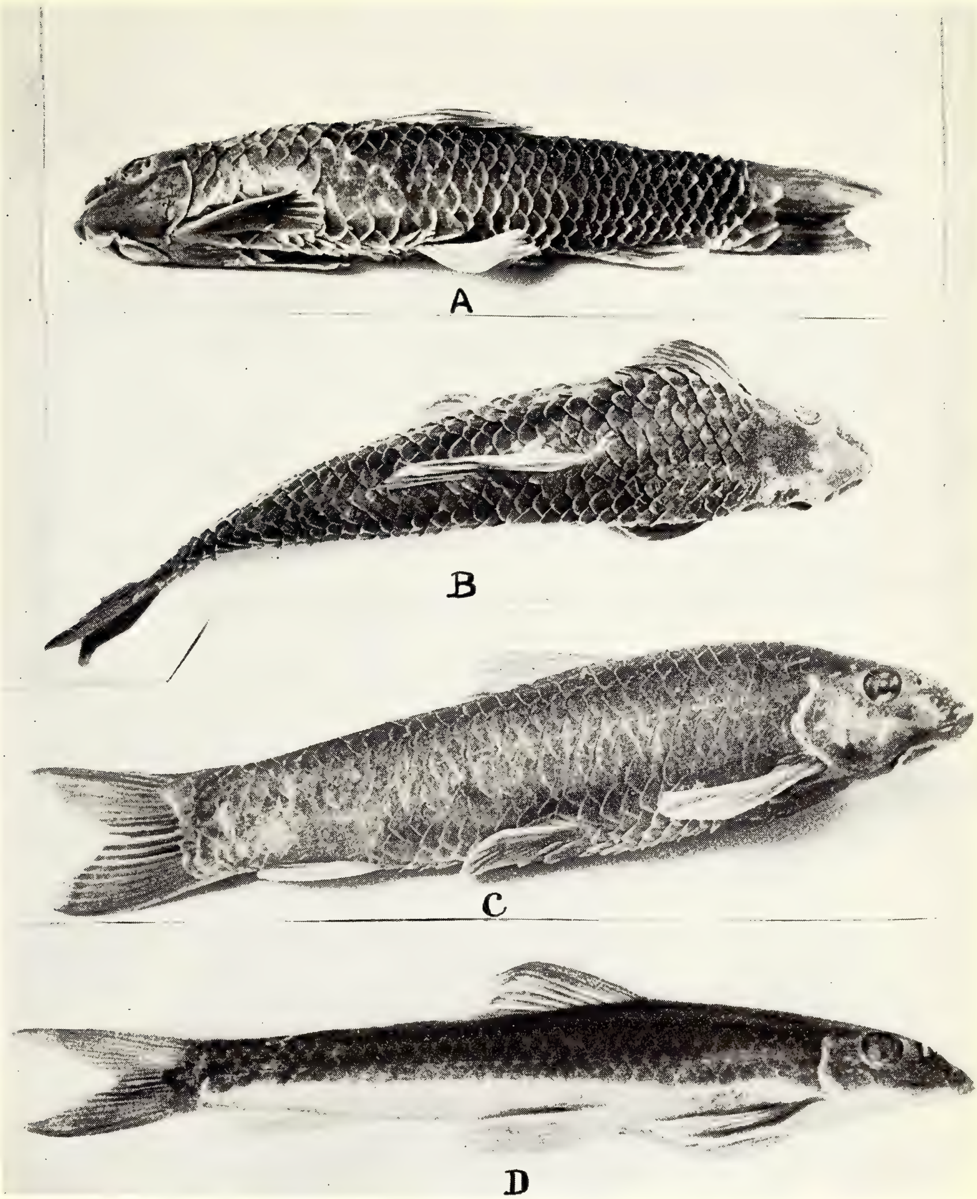
Garra jerdonia Day, *Proc. Zool. Soc. London,* p. 288 (1867). Type locality : Bhavani River at foot of Neilgherries and also Wynaad.

Discognathus jerdonia Day, (in part), Fish. India **2,** p. 528, pl. cxxii, fig. 6 (1877).
Discognathus jerdonia Day, (in part), Fauna Brit. India. Fish **1,** p. 247 (1889).
Discognathus lamta Jenkins, (in part), *Rec. Ind. Mus.* **3,** pp. 291-293 (1909).
Discognathus jerdoni Annandale, (in part), *Rec. Ind. Mus.* **18,** p. 73 (1919). [Pl. ix, fig. 2 ; pl. xi, fig. 3 and not pl. ix fig. 1, which probably represents a specimen of *Garra lamta* subsp. *mullya* (Sykes,)]
Discognathus elegans Annandale, *Rec. Ind. Mus.* **18,** p. 76, pl. ix, fig. 4 ; pl. xi, fig. 5 (1919). Type locality : Bhavani River at base of Neilgherries.
Garra jerdonia Rao, *Ann. Mag. Nat. Hist.* (9), 4, p. 53 (1920).
Garra platycephala Rao, *Ann. Mag. Nat. Hist.* (9), 4, p. 56, pl. i, figs. 2, **2***a*, 2*b*, (1920). Type locality : Cauvery River at Seringapatam, Mysore.
Garra stenorhynchus Hora, (in part), *Rec. Ind. Mus.* **22,** p. 653 (1921).
Garra jerdoni Hora, *Rec. Ind. Mus.* **22,** p. 657 (1921).
Garra lamta Rao and Seshachar, (in part), *Half-yearly J. Mysore Univ.* **1,** (2), p. 126 (1927).

Pillay (1929), Hora and Law (1941), and Silas (1951) have recorded *G. jerdoni* as occurring in the rivers draining the Travancore hills. The single specimen that I collected from the Peermed Hills (Periyar watershed) is different from the typical *G. mcclellandi* in many details. In view of its uncertain position, references to *G. jerdoni* fom Travancore are not included in the above list of synonyms. *Garra mcclellandi* appears to be restricted to the Cauvery watershed.

SYSTEMATIC POSITION OF *Gonorhynchus stenorhynchus* JERDON
(Plate, figs. A, B.)

Of the three species of *Gonorhynchus* described by Jerdon, this is the only species that has been recognised as valid by most of the earlier ichthyologists, although Günther (1868) placed it as a doubtful species under the genus *Discognathus* Heckel, and Day (1877) relegated it to the synonymy of the composite species *Discognathus lamta* (Hamilton). The single well-defined median proboscis of the snout is a sufficiently distinct character to separate *G. stenorhynchus* from other species of *Garra* occurring in peninsular India. Besides this, the following characters are equally important, and by them it can be distinguished from *Garra gotyla* Gray of northern India, which species is also characterised by the presence of a median proboscis on the snout. The characters referred to are (i) the more anterior position of the ' shoulder spot ' which does not extend behind the upper angle of the gill-opening. Annandale (1919) has correctly depicted its position in the drawing of *G. stenorhynchus* (Pl. ix, fig. 3), although its significance has never been commented upon. I consider this as an additional character of specific importance ; and (ii) the presence of a row of well-defined dark spots at the base of the branched dorsal fin rays, more clear from the third to the last branched rays. Many species of *Garra* lack this character, although it also occurs in species widely separated ; for instance in *Platycara notata* Blyth



Species of *Garra* Hamilton of the Cauvery Watershed

G. stenorhynchus (Jerdon): (A) Lateral, (B) Dorsal views of a specimen, 112 mm.; (C) *G. lamta* Hamilton, 106 mm.; (D) *G. mcclellandi* (Jerdon), 87 mm.
(The measurements in millimeters denote the standard lengths.)

Photos: E. G. Silas

(= *Garra notata*) of Burma, *G. tibanica* Trewavas and *G. brittoni* Trewavas from south-west Arabia, etc.

The frequency distribution of the fin rays and scale counts are given in the tables on p. 530.

The striking resemblance of *G. stenorhynchus* to *G. arabica* Hora from Arabia is noteworthy and, as Trewavas (1941) has suggested, further collections of *G. arabica* from the Wadi Tiban basin will help to confirm the locality of the latter and also redefine the species. As it stands at present, but for the disjunct distribution I do not find any difference between *G. stenorhynchus* and *G. arabica* to consider them as specifically distinct. Even the shoulder spot in *G. arabica* seems to occupy a position identical with that seen in *stenorhynchus*, for Hora (1921, p. 679) notes the presence of ' an indistinct black dot on the operculum near its angle', which is unlike that seen in *G. lamta*, where the shoulder spot is behind the upper angle of the gill-opening, often entirely covering the first perforated scale of the line. Therefore, until fresh material of *arabica* is worked upon, it will be better to consider it as a geographical race of the earlier proposed species, *G. stenorhynchus*. Hora (1951) has given a complete list of synonyms of *Garra stenorhynchus* (Jerdon), which is to be accepted with one other minor change. *Gonorhynchus gotyla* Jerdon (*nec* Gray) does not belong to the synonymy of *G. stenorhynchus* but as pointed out earlier (p. 524.) is considered a synonymy of *Garra lamta* Hamilton.

CONCLUSION

The three species of *Gonorhynchus* described by Jerdon (1849) from the Cauvery River are re-designated here as follows :

1. *Gonorhynchus gotyla* Jerdon (*nec* Gray) = *Garra lamta* Hamilton.
2. *Gonorhynchus McLellandi* Jerdon = *Garra mcclellandi* (Jerdon).
3. *Gonorhynchus stenorhynchus* Jerdon = *Garra stenorhynchus* (Jerdon).

The study of the species of *Garra* from the Cauvery drainage once again emphasises the view expressed earlier (Silas, 1954) that the ' maze of species that are known at present to constitute the genus *Garra* seems definitely separable into different species-groups including polytypic species with infra-specific levels of differentiation . . . . '. The *G. lamta*-group has a range covering a greater extent of the distribution of the genus and is represented in the different drainages of the different geographical areas by species and subspecies. *G. mcclellandi*, with a higher scale count, more anteriorly situated vent, etc., seems to fall under a separate species-group which has representatives in north-eastern India and probably also as far east as Yunnan, south China, and Indo-China. The third species, *G. stenorhynchus*, belongs to the *Garra gotyla*-group which probably also extends westward as far as Arabia. It is hoped that, when the genus is fully worked upon, the points raised here and the questions left unanswered will be clarified.

Summary

The nomenclature of three species of Indian cyprinid fishes described by Jerdon in 1849 under the genus *Gonorhynchus* McClelland have been clarified and the species redefined as *Garra lamta* Hamilton, *Garra mcclellandi* (Jerdon), and *Garra stenorhynchus* (Jerdon). Attention is drawn to the variations in certain features, especially the horny tubercles on the snout, scalation, etc. The studies also point to the possibility of inter-specific hybrids of species of *Garra* occurring in the Cauvery watershed. The above three species of *Garra* appear to belong to three distinct species groups.

TABLES SHOWING THE FREQUENCY DISTRIBUTION OF THE FIN RAY AND SCALE COUNTS IN SPECIES OF *Garra* FROM THE CAUVERY WATERSHED

Species	No. of lateral line scales						No. of predorsal scales			
	32	33	34	35	36	37	9	10	11	12
Garra lamta Hamilton ..	2	2	3	2	—	—	—	5	4	—
Garra stenorhynchus (Jerdon) ..	6	27	26	—	—	—	—	38	18	—
Garra mcclellandi (Jerdon) ..	—	—	—	14	15	1	—	26	2	—

Species	Scales around caudal peduncle				Scales between vent and origin of anal fin					
	14	15	16	17	4	5	6	6½	7	8
1. *Garra lamta* Hamilton ..	—	—	9	—	4	5	—	—	—	—
2. *Garra stenorhynchus* Jerdon ..	—	—	59	—	22	36	—	—	—	—
3. *Garra mcclellandi* (Jerdon) ..	—	2	28	—	—	—	—	1	20	9

Species	Scales between lateral line and origin of dorsal fin					Scales between lateral line and origin of pelvic fin				
	3	3½	4	4½	5	2	2½	3	3½	4
1. *Garra lamta* Hamilton ..	—	—	6	2	—	—	1	7	—	—
2. *Garra stenorhynchus* (Jerdon)..	—	1	50	6	—	—	1	53	3	—
3. *Garra mcclellandi* (Jerdon) ..	—	—	4	26	—	—	1	22	7	—

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Some Useful Weeds of Baroda, its Neighbourhood, and Pavagadh

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INTRODUCTION

Weeds grow everywhere and can tolerate almost any set of climatic conditions; they usually spring up with the first showers of the monsoon and continue as long as there is enough moisture in the ground.

We have been deeply interested in the study of the weeds occurring in the city of Baroda and its neighbourhood, particularly on Pavagadh Hill, 29 miles NE. of the city; we have made ample collections and recorded plenty of data, some of which we wish to present in the present paper. In our first paper we dealt with the weeds of the University Campus (1957); we paid attention to the various uses made of these weeds from the medicinal point of view; such information was obtained in the first instance from local Ayurvedic practitioners, and in this respect our data were of interest as being first-hand and authoritative.

In successive years we have extended the field of our activities to include the whole city of Baroda and the slopes of Pavagadh Hill. In the present paper we list only such plants as we have found to be used medicinally in the district under study. We give our plants following the order of Cooke's FLORA OF THE PRESIDENCY OF BOMBAY. The names enclosed within brackets after the scientific ones are names used locally for the plants.

LIST OF USEFUL WEEDS

PAPAVERACEAE

1. **Argemone mexicana** Linn. (Darudi)

A prickly herb, in flower most of the year. The oil from the seeds is used in skin diseases and ulcers. The roots are purgative.

CAPPARIDACEAE

2. **Cleome viscosa** Linn. (Kanfuti)

An erect, gladular herb; flowering in July to September. The juice of the leaves is used for headache and poured into ears for earache. The seeds are carminative and are used to kill intestinal worms.

3. **Gynandropsis gynandra** Briq. (Tanmani; Adhiyakaran; Aadiyakarson)

An erect herb, flowering in July to November. A decoction of the root is given in fever. The juice of the plant is useful for scorpion-sting and fever. It stops pains of the body and ear trouble. The oil is used for skin diseases.

CARYOPHYLLACEAE

4. **Polycarpaea corymbosa** Lamk. (Jinapan Okhrad)

A herb, flowering in September to October. The application of the vegetative parts cures poisonous bites.

PORTULACACEAE

5. **Portulaca oleracea** Linn. (Moti Luni)

A succulent prostrate herb, flowering in March to December (almost throughout the year). As a pot herb it cures the diseases of the blood and stops urinary troubles.

ELATINACEAE

6. **Bergia odorata** Edgew. (Lavariyu; Runvad)

A decumbent herb, flowering in March to November. A paste prepared from the plant is used on scorpion-sting.

MALVACEAE

7. **Sida veronicaefolia** Lamk. (Bhonyabala)

A prostrate spreading herb, flowering in September to January. The leaves are applied on cuts and bruises.

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[1] [Mhaskar. K. S., and Caius, J. F., in 'Indian Plant Remedies used in Snake bite' (*Ind. Med. Res. Memoirs*, No. 19, Jan. 1931) write : " We have every reason to believe that our work is exhaustive, and we may safely *conclude that none of the Indian plants recommended for the treatment of snake-bite has any preventive, antidotal, or therapeutic effect*." The same authors after an exhaustive study of plants or plant combinations used in the treatment of scorpion sting, write : " None of the Indian Plant Remedies popularly used in the treatment of scorpion sting has been found to have any preventive, antidotal, or therapeutic effect."—EDS.]

8. **Sida spinosa** Linn. (Kantalobal; Gangeti)

An erect herb, flowering in October to April. The plant cures wounds, ulcers, and disorders of the bile. The root is a tonic, good for heart disease and asthma.

9. **Sida acuta** Burm. (Bala)

An undershrub, flowering in September to December. The root is utilised in nervous and urinary diseases.

10. **Sida cordifolia** Linn. (Mahabala; Khapat)

A velvety herb, flowering in September to December. The juice of the roots, leaves, and bark heals ulcers and wounds. Plant is used for urinary diseases, disorders of blood, and scurvy. The roots are applied on scorpion-sting.

11. **Abutilon indicum** Sweet (Kansaki)

A tall herb, flowering in May to November (almost throughout the year). The roots are used for fevers, cough and leprosy. The roots and leaves are taken internally for snake bite and urinary troubles.

TILIACEAE

12. **Triumfetta bartramia** Linn. (Jipati)

An undershrub, flowering in August to September. The plant increases the secretion of milk in females. It reduces swellings. The seeds are given in cases of dog-bite. The leaves are used in dysentery.

13. **Triumfetta rotundifolia** Lamk. (Jipato)

A herb or an undershrub, flowering in August to October. Used as a demulcent.

14. **Corchorus aestuans** Linn. (Jiteli)

An erect or prostrate herb, flowering in August to October. The seeds are used in pneumonia and the roots for cough.

ZYGOPHYLLACEAE

15. **Tribulus terrestris** Linn. (Gokharu)

A spreading herb, flowering in August to October. The entire plant with its fruits is useful in kidney diseases and for ulcers.

OXALIDACEAE

16. **Oxalis corniculata** Linn. (Aamalati; Khati Luni)

A tiny creeping herb, flowering in July to October. The plant is a remedy for scurvy and is given to relieve the effects of opium. Good for head-ache.

PAPILIONACEAE

17. **Tephrosia purpurea** Pers. (Sarapankho)

An undershrub, flowering in June to November. The plant is a tonic and has the property of purifying the blood. A decoction of the root is used for urinary troubles and its smoke stops cough. Oil from the seeds is best for eczema.

CAESALPINIACEAE

18. **Cassia occidentalis** Linn. (Kasundaro)

An undershrub, flowering in August to December. Externally, the seeds and leaves are applied on skin diseases, and for swellings. The roots are used in snake bite. Leaves are good for asthma, cough, and indigestion. The fruits are also used for cough.

19. **Cassia tora** Linn. (Kunvadiyo)

An erect herb or an undershrub, flowering in July to October. Used as a pot-herb, only after the first showers of rain, and has the property of curing cough, asthma, leprosy, and gastric troubles. It kills intestinal worms. Good for headache and promotes urinary discharges. The roots and seeds are applied on swollen parts and skin diseases. The roots purify the blood. An infusion of the plant is given to the animals infested with worms.

CUCURBITACEAE

20. **Coccinia indica** Wt. et Arn. (Tindora; Gholi; Gilodi)

A climber, flowering in July to September. The juice of the leaves and roots has a cooling effect and is used in diabetes. The flowers are used in disorders of the bile and jaundice. The fruits are applied on swollen parts and are used for disorders of the blood. As a pot herb it cures anaemia.

MOLLUGINACEAE

21. **Trianthema monogyna** Linn. (Vasu)

A prostrate succulent herb, flowering in April to November. The juice of the plant is a tonic for old age. A decoction of the roots is used for fevers, swellings and scorpion-sting.

RUBIACEAE

22. **Oldenlandia corymbosa** Linn. (Pitpapdo)

A small, delicate herb; flowering in July to October. The juice of the plant has a cooling effect. Used in jaundice. It is a blood purifier.

23. **Borreria hispida** Schum. (Madhuri Jadi)

A small herb, procumbent as well as decumbent; flowering in July to October. The plant is used in toothache.

COMPOSITAE

24. **Vernonia cinerea** Less. (Shahadevi)

A herb, flowering in July to September. The plant juice cures piles. The root is useful for dropsy. The juice of the roots is used in fever.

25. **Ageratum conyzoides** Linn. (Makadmari ; Ajgandha)

An erect herb, flowering in August to February. The plant is used for leprosy and diseases of the skin. The leaves heal cuts.

26. **Grangea maderaspatana** Poir. (Mundi)

A prostrate spreading herb, flowering in April to July. The juice of the plant is useful for irregular menses and pains of the ear.

27. **Sphaeranthus indicus** Linn. (Bodiyo Kalhar; Kalar; Gorakh Mundi)

A herb, flowering in December to January. The plant is a tonic used for ulcers, cough, anaemia, and asthma. The juice of the plant cures jaundice, leprosy, gastric troubles, wounds, and disorders of the bile. The fruits are applied for rheumatism.

28. **Xanthium strumarium** Linn. (Gadariun)

A herb, flowering in September to April. It is useful in malaria and improves appetite.

29. **Eclipta prostrata** Linn. (Bhangro)

An erect or prostrate herb, flowering in July to December. The root is useful for skin diseases. The plant has a cooling effect for the eyes, and keeps hair black if mixed with the oil. Used for cough, asthma, leprosy, and anaemia. It checks sexual appetite.

30. **Tricholepis glaberrima** DC. (Utkatari; Utkanti)

An erect, spinous herb; flowering in January to April. The plant is a tonic. The roots and seeds are useful. The root bark is used in urinary troubles. The roots are applied on snakebites and scorpion-stings. The roots if taken internally cure cough.

31. **Launaea nudicaulis** Hook. f. (Bhonypatri)

A prostrate spreading herb, decumbent; flowering in June to March. It checks fever.

ASCLEPIADACEAE

32. **Calotropis gigantea** R. Br. (Aakado)

A milky shrub, flowering throughout the year. The plant is a superlative remedy for leprosy, piles, intestinal worms, cough, dropsy, and skin diseases. It is good for digestion. Application of the milky juice relieves ordinary pains of the body. It is purgative. The roots are used for jaundice and its bark enhances perspiration. Oil boiled with the leaves is applied in paralysis. The leaves are used for headache and serpent bite. The flowers cure fevers and cough.

33. **Calotropis procera** R. Br. (Dholo Aakado)

A small shrub, flowering throughout the year. Its uses are the same as those of *C. gigantea* R. Br.

34. **Leptadenia reticulata** Wt. et Arn. (Nani Dodi)

A twiner, flowering in May to October. The plant is a tonic and a substitute for vegetables.

GENTIANACEAE

35. **Enicostemma verticillatum** (Linn.) Engler. (Kadavi Nai)

An erect herb, flowering in June to September. The plant purifies the blood. It is also used for hernia.

BORAGINACEAE

36. **Coldenia procumbens** Linn. (Okhrad)

A procumbent herb, flowering in August to October. The leaves are used for boils and rheumatism.

37. **Heliotropium marifolium** Retz. (Hathi Shundhan)

A decumbent herb, flowering in June to September. Tender shoots of the plant cure ulcers. The leaves are applied on scorpion-sting.

CONVOLVULACEAE

38. **Evolvulus alsinoides** Linn. (Jini Fudardi)

A prostrate herb, flowering in June to December. The plant is used in dysentery and is a good tonic for asthma.

39. **Convolvulus microphyllus** Sieb. ex Spr. (Shankhavali)

A prostrate herb, flowering in June to January. The juice of the plant with honey stops nausea, and is a tonic for delirious persons.

40. **Merremia emarginata** Hall. f. (Under Kani)

A small creeping herb, flowering in July to October. The juice of the plant is used in cases of rat-bite.

SOLANACEAE

41. **Solanum nigrum** Linn. (Piludi)

An erect herb, flowering in June to January. The juice of the plant is useful for piles and stops blood-vomits. The fruits are used in fever. An infusion of the leaves is used to remove the effects of opium. The plant is used as a pot herb for disorders of the bile.

42. **Solanum xanthocarpum** Schr. et Wendl. (Bhony Ringani)

A prostrate, spreading, spiny herb; flowering in January to May. The plant is used in asthma and relieves pains of the body. A decoction of the roots is good for cough and fevers. The fruits are smoked to relieve pain caused by decayed teeth. The application of the juice of the plant with honey is highly praised as a remedy for baldness.

43. **Physalis minima** Linn. (Popti)

A herb, somewhat procumbent; flowering in August to September. The plant is a tonic. It increases secretion of milk.

44. **Withania somnifera** Dunal. (Ghoda Aasun)

A small hairy undershrub, flowering in September to March. The plant cures weakness and is good for fever.

45. **Datura metel** Linn. non auct. plur. (Dhanturo)

A small, succulent shrub; flowering in September to March (almost throughout the year). The fruit boiled in sweet oil is a superlative remedy for skin diseases. All parts of the plant are smoked in to cure cough. The juice of the plant is used for mumps and guinea-worm. The leaves and roots are applied on scorpion-sting and swollen parts.

SCROPHULARIACEAE

46. **Bacopa monnieri** Pennell. (Jalnevari ; Bam)

A prostrate, spreading, succulent herb; flowering in August. Useful as a tonic in nerve weakness, asthma, and rheumatism.

47. **Striga euphrasioides** Benth. (Dholo Aagiyo)

An erect herb. Root parasite on grasses. Flowering in July to October. The plant improves appetite.

48. **Lindenbergia indica** O. Kuntze (Bhint Chatti)

A small, glandular herb. Lithophyte. Flowering in August to November. The juice of the plant is used in chronic bronchitis.

OROBANCHACEAE

49. **Orobanche nicotianae** Wight (Vakunbo)

A herb. Root parasite on tobacco plants. Flowering in December to February. A fodder for cattle.

ACANTHACEAE

50. **Peristrophe bicalyculata** Nees. (Kali Anghedi)

A herb, flowering in August to January. Used in snake bite.

51. **Rungia parviflora** Nees. (Khadsheliyo)

A decumbent herb, flowering in August to October. Used in fever and cough.

VERBENACEAE

52. **Phyla nodiflora** Greene (Ratveliyo)

A prostrate, creeping herb; flowering in June to October. An infusion of the leaves is given to children suffering from indigestion.

LABIATAE

53. **Ocimum gratissimum** Linn. (Aavachi-Bavachi)

A herb, flowering in July to October. The seeds are used for headache and dysentery. The juice of the plant stops nausea.

54. **Anisomeles indica** O. Kuntze (Chodharo)

An erect herb, flowering in June to October. The plant is used as a tonic in uterine affections and fevers.

55. **Leucas aspera** Spreng. (Kubo)

An erect herb, flowering in August to November. The juice of the leaves is used for scabies, jaundice, fevers, and swellings.

NYCTAGINACEAE

56. **Boerhavia diffusa** Linn. (Punnarnava ; Satodo)

A decumbent herb, flowering in March to November (almost throughout the year). The plant is applied on swollen parts and cures ulcers of animals. The plant is highly praised for its property of curing dropsy. It promotes urinary discharges. The roots are used in opthalmic troubles, jaundice, and asthma. It stops disorders of the brain and fever.

AMARANTACEAE

57. **Digera muricata** Mart. (Kanajero)

A small herb, flowering in July to September. The plant is used as a vegetable and has a laxative effect.

58. **Amarantus spinosus** Linn. (Kantalo Dabho)

An erect, spinous herb; flowering in August to September. The root is used in eczema. The leaves are sometimes used as a vegetable and have a cooling effect.

59. **Amarantus gracilis** Desf. (Dhimado)

An erect herb, flowering in August to September. Young shoots are eaten.

60. **Amarantus polygamus** Linn. (Tandalajo)

A herb, flowering in August to September. Used as a vegetable and cures bowel trouble. The leaves have a cooling effect. It stops cough and purifies blood. Used on scorpion-sting. A good tonic for dropsy.

61. **Aerva lanata** Juss. (Kapuri Madhuri)

A herb, in flower most of the year. The root is useful for headache.

62. **Achyranthes aspera** Linn. (Anghedo)

A herb, flowering in September to February. The entire plant and the seeds are useful. It is highly praised for stopping nausea. It cures fever, cough, indigestion, toothache, dropsy, swellings, and skin diseases. Its stem is very good for cleaning the teeth. The bark or the roots are applied on scorpion-sting. The leaves cure piles. An infusion of the young shoots or the seeds with honey is used for rat-bite.

63. **Alternanthera sessilis** R. Br. (Jal Jambvo ; Panini Bhaji)

A prostrate, spreading herb; flowering in July to September. The plant is a good tonic and is used for dropsy.

CHENOPODIACEAE

64. **Chenopodium album** Linn. (Chilni Bhaji)

A herb, flowering in January to April. Used chiefly as a vegetable. It is laxative and purifies the urine. The juice of the plant is applied on burns.

ARISTOLOCHIACEAE

65. **Aristolochia bracteata** Retz. (Kidamari)

A prostrate herb, flowering in June to September. The plant juice is applied for ulcers in animals. Cures fevers and intestinal worms. Applied on swollen parts.

EUPHORBIACEAE

66. **Euphorbia hirta** Linn. (Nagala Dudheli)

An erect herb, flowering in June to November (almost throughout the year). The plant is used in bowel troubles.

67. **Phyllanthus niruri** Linn. (Bhonya Amli)

A small, erect herb; flowering in June to September. The entire plant is used in fever. It cures disorders of the blood and bile. The leaves are used for jaundice, anaemia, and cough.

68. **Chrozophora prostrata** Dalz. (Betho Okhrad)

A prostrate herb, flowering in May to June. It is used for cold and cough. The seeds are purgative.

69. **Acalypha indica** Linn. (Dadaro ; Vinchhi Kanto)

An erect herb, flowering in July to November. The plant is useful in bronchitis and pneumonia.

COMMELINACEAE

70. **Commelina nudiflora** Linn. (Aakhalo-Bokhalo)

An erect herb, flowering in July to October. Its application is good for burns.

CYPERACEAE

71. **Cyperus rotundus** Linn. (Moth)

An erect, glabrous herb; flowering in July to October. The tubers are used for disorders of the stomach.

GRAMINEAE

72. **Eragrostis** sp. (Dabha ; Darbha)

A slender, glabrous grass; flowering in July. Very good fodder grass. The roots are used in fevers and cough, and promote urinary discharges.

73. **Cynodon dactylon** Pers. (Daro)

A perennial grass, flowering in July to October. It is used in Hindu pujas for Lord Shri Ganesh. It is best for lawns. A good fodder grass. An infusion of the plant stops bleeding from piles. Used in haemorrhage, eczema, and brain troubles. Stops nausea and fevers. It is a very good remedy for irregular menses. It is said, and believed by the public, that the roots tied with cotton thread to the hand stop fevers.

SUMMARY

The present paper puts on record the useful weeds occurring in the city of Baroda and on the Pavagadh Hill mentioning their medicinal properties. Such information was obtained in the first instance from local Ayurvedic practitioners. This paper is based on the collections made during the years 1954 to 1957. The names used locally for all the weeds occurring in these areas are also given.

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Reviews

1. SOONDAR MOONI. By E. O. Shebbeare. Pp. 224 (21.5× 13.5 cm.). Line drawings and maps by the author. London, 1958. Victor Gollancz Ltd. Price 18*s*.

Mr. Shebbeare is well known in India as having acquired an almost unrivalled knowledge of forests, elephants, and other wild life of north and north-east India prior to World War II when he became Game Warden of Malaya. He had a distinguished career, having been on two Everest Expeditions and having finished up as Head of the Forest Department of Bengal. A very keen observer of natural history, particularly of wild (and tame) elephants, it is fitting that he should now have produced what must be one of the best books yet written on the Indian (or Asiatic) elephant.

Many writers on elephants tend to invest this creature with great intelligence and a certain amount of glamour in order to give their subject popular appeal. Some prefer to attempt to debunk the elephant legends. Mr. Shebbeare does neither of these, but in an enchanting story of an individual elephant in north-east India he depicts the life-history of one of these animals, elephant herd life in the wild, how these animals react to various natural and man-caused incidents, how they submit to capture, training and working for man, and thus lays on record a vast amount of first hand and authentic information on the subject. Though the story is mostly told through the eyes and mind of an elephant, there is a minimum of anthropomorphistic approach on the part of the author to his subject. Many years of close observation appear to have given the author an almost uncanny gift of being able to gauge the probable thoughts of elephants when confronted with various situations, both in their wild state and after capture and training.

There are numerous interesting references to other wild creatures in the book, to gaur, buffalo, tiger, leopard, bear, deer, and so on. The human inhabitants, moreover, of the locality are not excluded, and we are treated to realistic but very delightful descriptions of an elephant auction, of the great *melas* in Bihar, of tiger shoots and a host of other episodes. The author's line drawings are good enough to make us wish that there were more of them.

The main value of the book is that the author has given us a vast amount of valuable information on the Indian elephant. There are very few details on which anyone with experience of wild and tame elephants in this part of India could disagree. However, here are a few very minor criticisms. The drawing on the cover of Soondar

Mooni's mother is, judging from its hollowed head, of an older elephant than intended, and the baby is too large for a newly born one. The delightfully and amusingly expressed thoughts (on page 12) of a young elephant, so human and yet probably so typically elephantine also, could have been more appropriately attributed to a four or five year old calf than to a fourteen month one which would still be in the suckling, calf-at-heel stage. On page 19 the author states 'Although instances of a sort of David and Jonathan partnership between two young tuskers are not unheard of, bulls normally give one another a wide berth . . .' The reviewer has himself twice seen two wild *makhnas,* one fully grown and the other three-quarter grown, roaming together in the forest in close friendship; while he is informed by an Assamese friend, noted for his experience of elephant catching, that instances are common of wild bulls, two, three, or four (but not more) in number, forming a friendship, and that this is known as *maljuria* or 'wrestler-friends'.

The two year old Soondar Mooni, when captured with her mother, is described (page 80) as following the *koonkies* loose after leaving the stockade, and later (page 84) as returning to suckle her tied-up mother in the training camp. The reviewer has often seen calves of this age taken out of the stockade, and they have always been roped to a koonkie and have never suckled their mothers again. In fact the elephant catchers say that the captured mother will not and can not suckle her calf after the shock of capture. On page 102 the author says that Soondar Mooni's mother held up training 'by trying to stand on her head'. Possibly he must be speaking figuratively, as the reviewer has never seen an adult newly captured elephant trying to do this when struggling, though of course young baby elephants often do this.

Most of the facts of the author's distinguished career are given on the dust cover, with further information amusingly detailed in the Introduction by the Australian Minister for External Affairs, who was Governor of Bengal at the time of Mr. Shebbeare's return to India after the war when a tiger shoot was organized in his honour. What is not recorded is the fact that the author was one of the last of a dying race of forest officers in India who knew and loved their forests and the wild life therein more than the office chair, who (as 'the forester') 'slipped away to bed, where he put an alarm clock set for five under his pillow', and who would march on foot or on elephant-back through the forests until he came out the other side—no mean feat in north-east India.

This book is confidently to be recommended to all, both for its unique and authentic information about the forests, savannahs, elephants and other wild animals of north-east India, as well as for its delightful style which sustains the reader's interest from beginning to end.

E.P.G.

2. THE FLORA OF PURANDHAR. An Enumeration of all the Phanerogamic Plants discovered in Purandhar during the Years 1944-1956. By H. Santapau. Pp. 1-158. Oxford Book and Stationery Co. New Delhi and Calcutta. (Date of publication and price not given.)

In this book is given a list of the flowering plants collected by the author during his visits to Purandhar during the years 1944-56. The arrangement followed is that of Cooke in his FLORA OF THE PRESIDENCY OF BOMBAY, which is the same as that followed in Hooker's FLORA OF BRITISH INDIA. The author has, however, made some modifications in the delimitation of the families, as he has split the Leguminosae, the Geraniaceae, the Boraginaceae, the Urticaceae, the Amaryllidaceae, the Scitamineae, etc. He has, however, curiously kept the Coniferae between the Monochlamydeae and the Monocotyledons. The author has modernised the nomenclature of the species in accordance with the International Rules of Botanical Nomenclature. The total number of plants described is 680, belonging to 101 Families and 399 Genera. Such local lists of plants are very useful to the plant geographer in tracing the origin of the component elements of the regional flora. It would, therefore, have been useful if the author had also given the regional distribution of the species enumerated.

In the Introduction, the author has drawn attention to the large number of 'rare and very rare plants' that have been preserved on the spot. It is these which give clue to the origin and past history of the flora of the higher regions of the Western Ghats. The reviewer wishes to draw attention to two such plants *Delphinium dasycaulon* and *Geranium ocellatum* var. *himalaicum.* Both these are of west Himalayan origin and migrated to Western Ghats on the one hand and to Ethiopia on the other producing specialised varieties in each case.

The author has done a distinct service to students of the Bombay Flora by the publication of this enumeration, and deserves congratulations for it. The size of the book is rather odd. It would have been more useful if the volume had been printed in a size suitable for carrying in the field.

S.P.A.

3. THE A TO Z of DOGS. By Barbara Woodhouse. Pp. 122 (16.5×11 cm.). Max Parrish, London, 1958. Price 7*s.* 6*d.*

Those who like their information in packet form will welcome this little addition to the legions of books on dogs. The author, who has lots of practical and useful advice to give her readers, does so in the shape of answers to the sort of questions that we find in the doggy columns of the newspapers; but the answers are given at greater length and with more detail than is possible there. The range covered is wide and the average dog owner will find guidance in the book for most of the things he can tackle without expert help. With reference to the training of dogs she is of the opinion that there are two sides to the question, and she has established a residential boarding school where owners and pets can be taken in hand together. Not a few of us will agree with her, with an uncomfortable consciousness that in this respect we too are sinners.

D.E.R.

4. PALAEMON. By S. S. Patwardhan, D.SC. [Editor: Professor R. V. Seshaiya]. Pp. xx+102 (24.5×16 cm.) 65 text-figures. Calcutta: Zoological Society of India, 1958. Price Rs. 5.00.

The present monograph is largely a reprint of the first edition which was published in 1937 as memoir No. 6 in *The Indian Zoological Memoirs on Indian Animal Types* series under the editorship of the late Professor K. N. Bahl. It was out of print for several years and the issue of this edition meets a long-felt and pressing need of students and teachers of zoology in the Indian Universities.

The main body of the text and number of figures remain practically unaltered except for slight changes in the text at certain places clarifying some points which were left unexplained in the first edition. In addition there are introductory notes by the President and Editor of the Zoological Society of India, and the Convener of the Indian Zoological Memoirs Committee of the Society at the beginning, and a brief note about the Zoological Society of India at the end.

It is gratifying to note that the Zoological Society of India has now undertaken to edit and publish the *Indian Zoological Memoirs on Indian Animal Types* initiated by the late Professor K. N. Bahl. The present monograph is the first to be brought out under the auspices of the Society. It is neatly printed on semi-art paper. The illustrations are clear and well reproduced, and the attractive and strong rexine binding renders it suitable even for rough use on laboratory tables. In spite of rising costs of printing the issue is reasonably priced. Along with others in the series, this monograph will continue to enjoy the popularity that it has achieved, among students and teachers of zoology in the Universities. The Zoological Society of India, the Convener and members of the Indian Zoological Memoirs Committee deserve to be congratulated for the production of this excellent memoir, and we hope that new additions to the series will follow soon in quick succession to make the study of zoology in Indian Universities self-sufficient.

K.K.T.

5. A ZOOLOGICAL GUIDE TO THE ZOOLOGICAL GARDENS OF CEYLON. By Major Aubrey N. Weinman. Pp. ix+167 (18.5 cm.×12.5 cm.). 3 coloured, 1 black-and-white, 89 illustrations, and 1 pictorial map. Ceylon, 1957. Printed at the Government Press. Price ?.

This booklet pertains to the Dehiwala Zoo in Colombo, and is written by its Director who states that the main purpose of it is to sustain the interest aroused by a visit.

The bulk of the text is a general account of mammals, birds, reptiles, etc. arranged in systematic order. A number of species not exhibited in the Zoo are also mentioned. The short notes on the prominent characteristics of many animals, together with the large number of photographs (including three in colour) should certainly help to foster and sustain the interest.

An Appendix gives a list of plants, divided into flowering trees, shrubs, creepers, orchids, etc., and another the Sinhalese, Tamil, and scientific names of the different species exhibited.

In the Foreword, the Minister of Home Affairs to the Government of Ceylon states that, though he has travelled extensively and visited many zoos in different parts of the world, the beauty of the site of the Gardens is unrivalled by any other.

In Delhi a large and very picturesque area has been set apart for the building up of a zoological park, and it is hoped that this will soon be opened to the public. In other parts of India, however, many of the excellent zoos privately maintained by the rulers of the erstwhile States are now sadly deteriorating.

The Bombay Zoo administered by the Municipality is also in sorry circumstances and it is possible that the appointment of an Advisory Committee and allocation of adequate funds would assist in the removal of some of the existing drawbacks. Such a committee is attached to the Zoological Gardens of Ceylon and includes members of the Fauna Protection Society, the Department of Wild Life, and other individuals interested in the subject.

The Ceylon zoo authorities are certainly to be congratulated on the production of this excellent booklet, which is to be followed by Sinhalese and Tamil editions.

H.A.

6. THE DARWIN READER. Edited by Marston Bates and P. S. Humphrey. Pp. ix+481 (22.5 cm.×15.5 cm.). With one plate and several illustrations. London, 1957. Macmillan & Co. Ltd. Price 30*s*.

The name of Charles Darwin, the proponent of the theory of Organic Evolution through Natural Selection or the Survival of the Fittest needs no special introduction to our readers. The year 1959 has a special significance to all biologists as it marks the one hundredth anniversary of the publication of Darwin's epoch-making treatise THE ORIGIN OF SPECIES—a classic containing deductions based on years of painstaking research and field observations. Although highly controversial and inviting unprecedented criticism from all quarters, including some of his eminent fellow biologists, by publishing this book Darwin gave a new outlook to the science of biology and his thoughts and ideas embodied therein profoundly influenced the thinking world. Centennial celebrations are being held in various parts of the world to mark this milestone of progress in human endeavour to understand the laws of nature, and it is only fitting that a book containing extracts from Darwin's various writings in the form of an easily readable account should be published about this time.

Darwin was a prolific writer and to read and digest the mass of material that he wrote would be a task to any biologist, leave alone the layman naturalist! Mr. Bates and Mr. Humphrey, the editors of THE DARWIN READER, have in this book attempted to collate in a concise readable form extracts from Darwin's most important books, THE VOYAGE OF THE BEAGLE, THE ORIGIN OF SPECIES, THE DESCENT OF MAN, THE EXPRESSION OF EMOTIONS, THE AUTOBIOGRAPHY, and his published researches on plants and worms. Their choice of extracts from the THE AUTOBIOGRAPHY for the opening chapters of the book seems most appropriate as they are in Darwin's own words and are the best introduction to his work. The remaining five parts of the book contain extracts from the aforesaid works of Darwin, but it is regrettable that selections from the most voluminous book THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION should not find a place in this compendium. However, reference is made in the brief editorial introduction to the interesting but now obsolete theory of ‘Pangenesis’ which Darwin developed. A bibliography of Darwin’s writings and important books dealing with Darwin’s biography, Darwinian influence, and contemporary evolutionary theory are given in a useful Appendix, and a thirteen page index concludes the book. The editorial notes and comments are kept to the barest minimum designed to aid in continuity of reading.

In the selection of extracts the editors have striven to bring together those embodying the most important ideas of Darwin and as far as possible the most readable prose, thus making it a highly interesting account of the life and work of a genius. For a fuller appreciation of the importance of field observations in the natural sciences nothing would be better than a perusal of the works of this greatest of all naturalists. To those wishing to delve more into the subject, recourse to Darwin’s books in complete form, which are now available in reprint editions, will be necessary. THE DARWIN READER, easy to read and understand, should appeal to all those interested in the various disciplines of natural science and the phenomenon of evolution. This book is strongly recommended to all our readers and will form a valuable addition to any library.

E.G.S.

Miscellaneous Notes

1. TIGERS AND PORCUPINES

I used to wonder in my young days why a tiger, being such an intelligent and cautious animal, should kill a porcupine when other natural food was available. After many occasions for observation in the jungles by following tigers with a pair of binoculars from a safe distance, I am inclined to believe that the porcupine attracts the attention of the tiger due to the tastiness of its meat. For the tiger the porcupine is a toothsome morsel, and in spite of the protection afforded it by the pointed spines and quills the tiger does not hesitate to face the dangers involved. I have myself seen the peculiar way in which the tiger goes about to kill a porcupine. After his victim has been approached to a convenient distance, the tiger with a powerful stroke tosses the porcupine in the air and may give another blow if necessary. The porcupine usually hits a stone or some other hard object becoming unconscious and exposing its vital parts.

In the process of attacking its prey in this manner accidents are likely to happen. For example, small quills may get lodged in the tiger's pads while striking the animal which may be very difficult to extract by means of his teeth. Subsequently these may penetrate deeper into the festering wound and disable him in time.

Another likely place for wounds from a porcupine's quills is the mouth, or even the intestine. On many occasions I have found small quills in a tiger's droppings which had passed through the alimentary canal. All the same, there is a danger of some pieces of quills sticking in the intestines and causing ulcers. In fact, one such tiger was found dead on the banks of Shikarghar Tank, near Banbihar Sanctuary in 1943, in a skin and bone condition. The intestine of this animal had several ulcers in a festering state inside which pieces of porcupine quills were found. Another example of disability due to porcupine spines was that of a tigress destroyed by us in Dholpur on 5th May, 1945. For some days complaints were being received from an adjoining village about a tigress killing cattle at the rate of four or five animals a day. The peculiarity of these kills was that only the soft parts such as udder, testes, etc. were eaten and the rest of the carcass left untouched. Things came to a head when the tigress attacked a 10 year old boy from a field hutment of Maharajpura village, adjoining the Ramsagar Sanctuary. A hunt was organised and the tigress eventually traced and destroyed. Examination showed that the mouth of the animal was in a diseased condition with large ulcers forming on the lower jaw. On cleaning and removing the flesh from the affected part I found a growth of deformity of the bone around the molars on the right hand part of the jaw with a piece of porcupine quill stuck inside. In this diseased condition the tigress was unable to hunt her natural prey and had no other recourse but to seek easier prey in cattle and men. This is a good example proving that porcupine quills may be responsible for turning a tiger into a man-eater.

Porcupines, it seems to me, are a potential source of danger to tigers and possibly also to other carnivorous animals in wild life sanctuaries. They are harmful likewise to the vegetation and trees, the roots of which are a part of their regular diet. There is definitely a case for the collection of more data regarding the ecology of porcupines with a view to determining whether, and to what extent, their elimination from wild life sanctuaries is desirable.

SANDS FORT,
DHOLPUR (C. RLY.), SARDAR BHUPENDRA KUMAR
RAJASTHAN,
July 16, 1958.

[The specimen was sent to the Bombay Veterinary College and we have received a note from the Principal which reads:

'The specimen sent by you consists of the lower jaw-bone (mandible) of a tiger. In the region of the molars on the right side, an irregularly spherical swelling has formed on the bone. It has a rough porous surface and a cavity on the inside. The cavitation has extended to the last molar posteriorly involving half of its root, and the first molar anteriorly involving the posterior half of its root. The second molar is absent in the specimen and must have dropped out owing to the destruction of the bone which held it in place.

'The nature of the lesion indicates that it was produced by suppurative osteitis caused by a wound and its subsequent infection. The wound might have been caused by any pointed object such as a porcupine quill as suggested.

'In suppurative osteitis there is a destruction of the bony tissue in the infection, resulting in its rarefaction. New bone may form under the periosteum which is not involved in the inflammatory process. Due to the rarefaction of the bone in the region, the second molar must have dropped out. The complete destruction of the alveolus of the second molar suggests that the wound must have been caused in the region of the second molar and not at the third molar as is suggested by the present position of the quill, since, the inflammatory process spreads centrifugally from the focus of infection.

'Suppurative osteitis is an extremely painful condition. The bone becomes weak and may fracture even by slight force. This explains the peculiar food habit of the tiger of devouring the soft parts alone of its prey.'—EDS.]

2. A MUSK SHREW ATTACKING A SNAKE

The common musk shrew, *Suncus murinus,* is responsible for destroying a great many creatures that are harmful to mankind like cockroaches and other insect pests. It is known to feed upon a scorpion and even to attack a large frog (Blanford, W. T., 1888, THE FAUNA OF BRITISH INDIA MAMMALIA: 236-237). The author has not come across any record of the shrew attacking a snake.

In the last part of June 1957, one evening, a musk shrew was discovered by me dragging a keelback (*Natrix stollata*) into my house. The snake was a little under 1½ feet long; its head was badly damaged and the snake appeared to have been freshly killed. Apparently the shrew had killed it.

DEPARTMENT OF ZOOLOGY,
RAVENSHAW COLLEGE,
CUTTACK,
July 22, 1957.

B. K. BEHURA

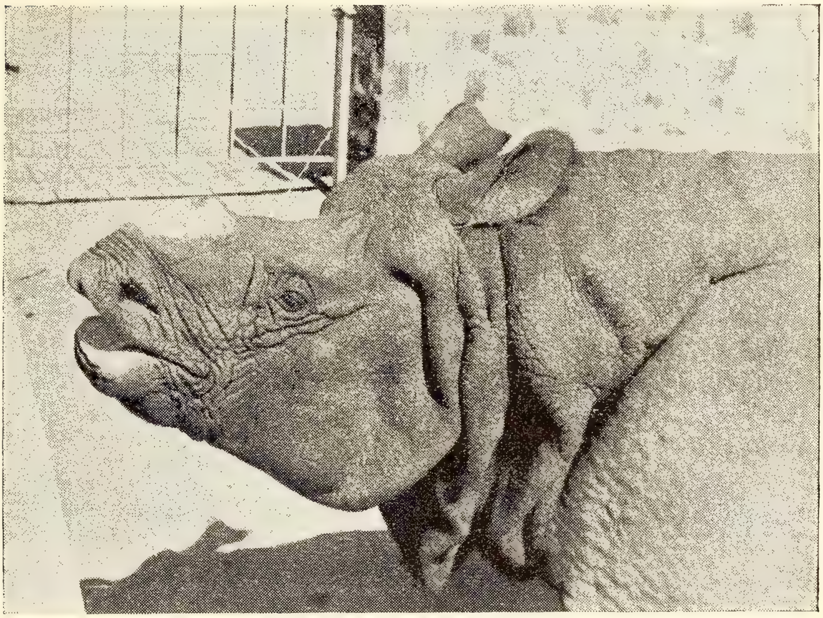
[The normal food of the musk shrew consists of cockroaches and other insects, but it is known to kill and eat bull-frogs [Wasey, G. K., *JBNHS* **10** (2): 330-331], toads [Prall, S.E., ibid. **13** (4): 669-700], guinea pig sucklings [Bannerman, W.B., ibid. **16** (4): 751-752]. It also eats vegetable matter such as roots (bulbs) of the 'bimli' grass and coconut pulp [Millard, W. S., ibid. **27** (1): 164]. Sterndale (MAMMALIA OF INDIA: 84) mentions bread and even scorpions as forming part of its diet. It is said to eat rice and grain too, but opinion seems to differ on this point.

Although in this case the evidence of killing the snake is merely presumptive, it is an interesting record. We can trace no previous mention of a snake in the varied dietary of the musk shrew.—EDS.]

3. ABNORMAL SITE OF HORN-GROWTH IN *RHINOCEROS UNICORNIS* LINN.

(*With a photo*)

In June of this year I received from the Honorary Secretary (Mr. Humayun Abdulali) two samples of material removed from the head of a captive Indian Onehorned Rhinoceros (*R. unicornis*) living in the Bombay Zoo. One sample comprised a clipping from the normal anterior horn which, as is commonly the case in captive specimens, had been rubbed down by the animal almost to the general level of the muzzle. The second sample was taken from an irregular horny growth which had arisen between the base of the normal horn and the forehead—approximately midway.



Sections from the material from the abnormal site examined microscopically prove to be identical in structure with normal horn-laminated strands of keratin.

The question naturally arises as to whether this secondary growth is compensatory for the loss of the normal horn from the excessive degree of friction to which it is subjected in captive animals. But whether the answer to this be affirmative or negative, it is of interest to note that it is at this site that a second horn normally grows in the two African Rhinoceroses (*Diceros bicornis* and *Ceratotherium* *simum*) as well as in one smaller Asiatic species, the rare *Dicerorhinus sumatrensis*.

In connection with the rubbing down of the anterior horn Grzimek (1956)[1] remarks that captive rhinoceroses shed their horns about once every ten years and it takes approximately a year to become renewed.

THE ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK,
LONDON, N.W. 1,
July 17, 1958.

W. C. OSMAN HILL

4. RE-DISCOVERY OF THE SMALLER ASIATIC ONEHORNED RHINOCEROS (*RHINOCEROS SONDAICUS* DESMAREST) IN MALAYA

(*With a plate*)

Thanks to the helpful co-operation of Mr. Loke Wan-Tho of Singapore we reproduce two unique photographs of this 'extinct' rhinoceros obtained in Malaya under the most extraordinary circumstances. According to *The Straits Times* of Singapore (March 22, 1957) where the photographs were first published, they were taken by one Mr. P. G. Bazin of the Lima Blas Oil Palm Estate at Slim River in southern Perak. Ironically enough, the photographer had no idea of what he had in front of his camera! The young animal in the picture was identified by Mr. H. J. Kitchener, the Chief Game Warden of Malaya. In the account given by Mr. Bazin to *The Straits Times* it seems that the animal was first seen by the estate labourers, wallowing in a swamp by a field. It did not appear to be frightened but just got up from the wallow and slowly walked away regardless of the barking of dogs and chivvying by Mr. Bazin's Alsatian. The animal is said to have been followed for two hours along a forest road in a jeep at a distance of 10 yards behind, before it turned off into the jungle and disappeared.

The Smaller Onehorned, or Javan, Rhinoceros (*R. sondaicus*) was found in India within recent times but now appears to be extinct. In the last century it was recorded from the Rajmahal Hills (?), Sikkim Terai, Sunderbans and 'in the forest along the Mahanaddy River'. It was reported as frequenting swampy ground in the Sunderbans as well as dense hill forest up to altitudes of 4000 ft.

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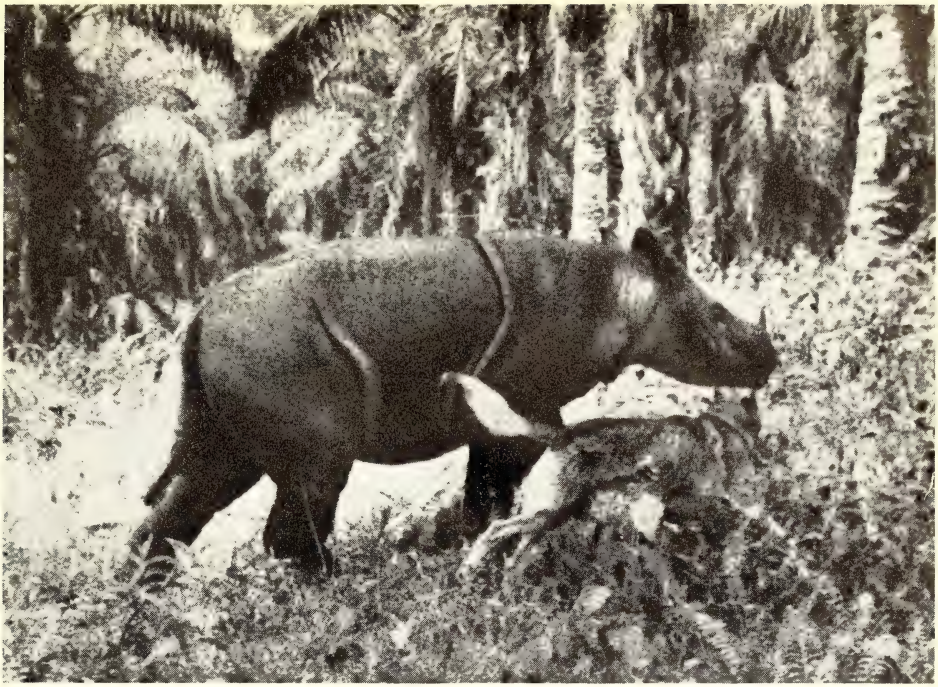
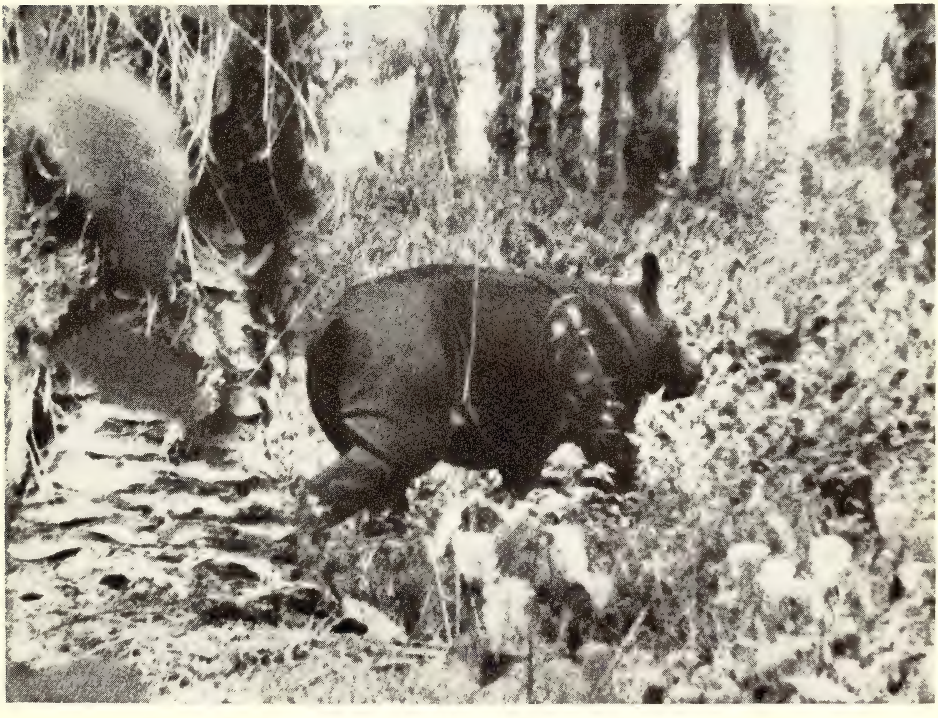
[1] Grzimek, B. (1956): NO ROOM FOR WILD ANIMALS, Thames & Hudson, London. (translated from Kein Platz für Wilde Tiere).





The young "*Rhinoceros sondaicus*" (?) photographed in Perak, Malaya

(By courtesy *Straits Times, Singapore*)

At the present time it apparently occurs in Burma in small and diminishing numbers, Thailand, Java, Borneo, and Sumatra.

It differs from the Great Indian Onehorned Rhino (*R. unicornis*) in being somewhat smaller; height at the shoulder *c.* 5 ft. 8 in. against up to 6 ft. Skin not tuberculated but with a mosaic-like pattern as on the flanks of a crocodile; throat folds less heavy; shoulder folds joining above neck to form an anterior saddle-like nape fold. Horn in females small or absent.

No reports of the existence of *R. sondaicus* in Malaya were available during the last 20 years, and the animal was believed to have become extinct. It may be recalled that Mr. R. C. Morris who led an expedition to Malaya on behalf of Mr. A. S. Vernay to procure a specimen of this rhinoceros for the American Museum of Natural History in 1935—curiously enough in the very area where these photos were taken—returned empty-handed without even seeing any footprints except those of the Twohorned, *R. sumatrensis*, or obtaining any other clues. Mr. Morris appeared to be of the view (*JBNHS* **38**: 446) that *sondaicus* no longer existed in Malaya and specimens would have to be procured from Sumatra where it is still found. It is believed that commercial poaching of the animal was largely responsible for its disappearance.

Theodore Hubback, during his term as Chief Game Warden, after prolonged search in Malaya found a single living example which he was so convinced was the last of its species (and mateless) that he permitted it to be shot for some American Museum 'in the interest of science'. How dangerous it is to feel so convinced in such matters is shown by the re-emergence of the present animal which, being only half grown, could conceivably have a mother and father still living. Mr. E. O. Shebbeare who followed Hubback as Game Warden in Malaya for several years before the War did not even see the tracks of this rhinoceros—all of which makes the present discovery still more astonishing.

Bombay Natural History Society,
114, Apollo Street, EDITORS
Fort, Bombay,
January 15, 1958.

[As the above note was about to go to press doubts arose in regard to whether the animal in the photos was really *R. sondaicus.* The chief reason for this doubt was the fact that one of the important keys to the identification of *R. sondaicus*, namely the prominent anterior nape fold formed by the joining of the shoulder folds on the neck [clearly shown in the excellent illustrations in the *Proc. Zool. Soc.*

London, 1874, Plate 28, and *J. Malayan Br. Roy. Asiat. Soc.*, 1937, **15** (2), Plates 3 and 4] is not visible in the picture. Mr. E. O. Shebbeare to whom the matter was referred, while still supporting Mr. Kitchener's identification of the animal as *sondaicus*, ended his letter by saying '. . . meanwhile I, for one, would be sorry to plump for either species as the original of the Lim Blas pictures'.

The matter must rest at this for the present, and we must await further conclusive evidence to dispel the doubts.—EDS.]

5. THE SHOU OR 'SIKKIM STAG'

AN APPEAL FOR INFORMATION ON ITS PRESENT STATUS

(*With one plate*)

A species of the Red Deer group known as the Shou (*Cervus affinis* Hodgson)[1] is probably nearing extinction, and any news of it would be most welcome. Unfortunately it is not found in India, not even in Sikkim although it is often referred to as the 'Sikkim Stag'. It is not found in Nepal. It is, or used to be, found in the Chumbi Valley of Tibet and sometimes in the adjacent valleys of north Bhutan, and then again in Tibet in the valley of the Tsangpo to the east of Lhasa.

R. Lydekker in his GAME ANIMALS OF INDIA (1924) states that the Shou was at one time reported to be plentiful in western Tibet, near the source of the Brahmaputra, and that a young stag was also caught in 1912 in the upper reaches of the Tsangpo Valley near the Manasarowar Lake; but in Rowland Ward's RECORDS OF BIG GAME (1928) is the statement: 'The Shou is not found within 200 miles of the Manasarowar Lake. The authority on which this incorrect statement was originally made was solely based on the fact that a single antler was found in a temple near the Manasarowar Lake (Major G. Burrard).'

R. Lydekker confirms that the Shou is not found in Nepal and Sikkim, and that its main habitat is the Chumbi Valley and that its range extends into Bhutan. He quotes from a letter to the *Field* of October 27, 1906, written by Lt.-Col. H. A. Iggulden as follows: 'My own observations and enquiries on this matter may be of interest to naturalists, for whilst in Tibet with the military expedition of 1903-1904 I made enquires regarding this stag, and saw a considerable number of skulls and horns at various places between our boundary on the Talep Pass (Jalep ?) and Lhasa. I came to the conclusion that these deer are not found to the west of a line drawn north and south between Shigatse and the northern point of Sikkim. They are

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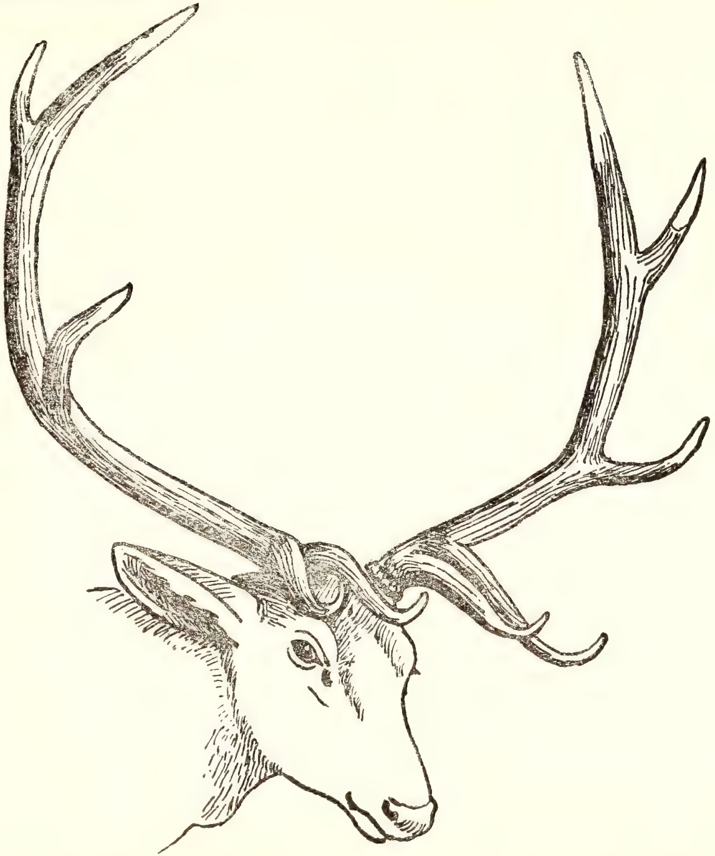
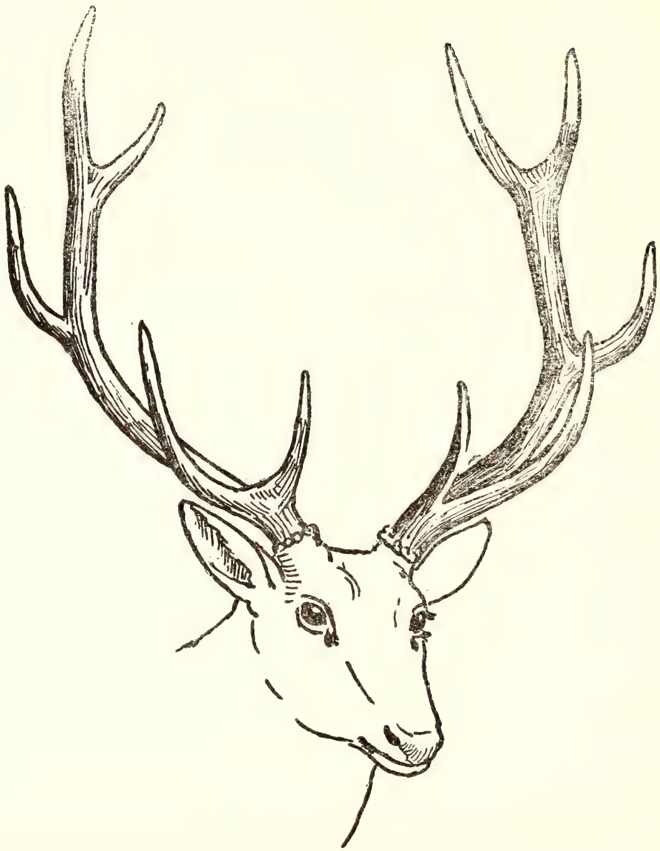
[1] = *Cervus elaphus wallichi* Cuvier.—EDS.



THE SHOU or SIKKIM STAG



THE HANGUL or KASHMIR STAG

never found in Sikkim itself, as the climate there is too damp, though one or two may possibly at times have crossed the boundary. There are a fair number in the Chumbi and branch valleys, which are well wooded, though they are probably more plentiful in some of the northern Bhutanese valleys. After leaving the Chumbi Valley these deer are not again encountered until the Tsangpo or Brahmaputra Valley is reached, where there are some herds of them in a valley to the north of the Kamba Pass, which were said to be protected by the Dalai Lama, and were consequently unmolested. They also inhabit the high mountains on both sides of the Brahmaputra for many miles to the east, probably as far as the unexplored Brahmaputra Falls. I next definitely heard of them existing in the bare hills to the north-east of Lhasa, and was told that they were occasionally seen and killed some few miles from that city.'

R. I. Pocock in 'The Larger Deer of British India' (*JBNHS* **43** (3), 1942) quotes a note from Col. F. M. Bailey on the distribution of the Shou based on his own experience: 'Shous used to be fairly common on the ridge east of the Chumbi Valley between that valley and Bhutan. East of this there used to be some in Bhutan. They lived I think, in Bhutan but came over the ridge into the Chumbi Valley in the summer and autumn. About November and December the Chumbi Valley people cut fuel for their winter supply. Deep snow does not usually come till later. This disturbs the forest and drives the deer back into Bhutan. In the summer of 1921 I saw two hinds and a young one above Lingmotang in the Chumbi Valley. There must have been very few left and I believe all were exterminated a few years ago, as I am told there are none in this part of Bhutan now. I saw a few in the district of Tsari. Here the Shou will be more or less artificially preserved for a long time I hope, as the place is very holy and no life may be taken there.'

The Shou is a fine deer, much larger than the Kashmir stag (*Cervus hanglu*)[1]. R. Lydekker in his ROYAL NATURAL HISTORY (1894) says: 'In addition to its superior dimensions, this deer is distinguished from the hangul by the beam of the antlers being strongly bent forwards just above the trez-tine; while the bez-tine is less constantly longer than the brow-tine. Each antler seems to have constantly but five points. Antlers have been measured of 54, 55, and 55¾ inches in length; anything like such dimensions being only very exceptionally attained by those of the Kashmir stag. The height of the animal is from 4½ to 5 feet at the shoulder'.

As Tibet and even Bhutan are 'out of bounds' to the ordinary person, this note is written in the hope that its appeal may reach those Indian Government officials whose work takes them near or into those parts, as well as the authorities of Tibet and Bhutan. If this fine deer is still in existence it is to be hoped that the authorities of the country and district concerned will take steps to safeguard it by legislation and by the creation of effectively controlled sanctuaries.

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[1] = *Cervus elaphus hanglu* Wagner.

There is no reason why the Shou should not do well in captivity, provided that it is kept off soft grassy ground and enclosed in suitable sloping, stony and rocky ground. The high altitude zoos or deer parks newly created in Darjeeling and Gangtok should suit admirably for the preservation and breeding of this species.

The writer of this note cannot do better than end this appeal with an extract from THE YEARS OF TRANSITION (1949) by the twelfth Duke of Bedford, who was one of the world's authorities on deer. He wrote: 'I understand that many, or most, of the fine deer of wapiti type inhabiting Central and Northern Asia are threatened with early extinction in districts where game laws are very unlikely to be applied or enforced. If therefore the world should ever return to that degree of comparative sanity at which large sections of the human race no longer desire to murder each other, it is most desirable that collecting expeditions should be organized to obtain breeding stocks of the big deer of Asia for preservation in captivity. Government Departments should assist this venture instead of hindering it by needlessly severe import restrictions'.

Any information received from any source about the Shou will be most gladly welcomed by the undersigned, who will compile it and forward to the appropriate interests.

OATING P.O.,
ASSAM, E. P. GEE
October 10, 1958.

6. A MYNA'S REMARKABLE ESCAPE FROM ELECTROCUTION

Hearing the excited chatter of Jungle Babblers, Common Mynas, and Redvented Bulbuls at 5.45 a.m. on 1st August, I went to see what the cause of the excitement was. I was at the scene in about 5 minutes and I found a Common Myna hanging limp from a live wire of the power line, its thighs touching a neutral wire below. Both its legs were gripping the live wire. Another myna was hanging with one leg on the live wire and the other leg on the neutral wire. Other mynas in a state of great excitement were flying around and alighting on the wires, sometimes dangerously close to the two unfortunate birds. The second myna struggled (convulsed ?) three or four times and about two minutes later got released from the wires and flew away followed by most of the mynas. A few mynas, babblers, and bulbuls lingered for a while near the dead bird before they too went away. The body of the dead bird remained hanging on the wire all day, but was not there the next morning.

42 TREVOR ROAD,
NEW FOREST,
DEHRA DUN, U.P.,
August 11, 1958.

JOSEPH GEORGE

[The remarkable thing about the above incident is that the second bird was not instantly killed by the initial shock, but in spite of remaining stuck to the live wire for a couple of minutes it managed to struggle and release itself and actually to fly away! Mr. George informs us that the power line carried a voltage of 230 A.C.—EDS.]

7. THE BLACKBACKED WOODPECKER, *CHRYSOCOLAPTES FESTIVUS* (BODDAERT), IN CHITTUR KERALA

Sálim Ali says (The Ornithology of Travancore and Cochin, *JBNHS* **38**: 784) that he saw the Blackbacked Woodpecker only once in the course of his survey. In Chittur (part of the old Cochin State), altitude approx. 400 ft., and miles away from any kind of forest, I saw this bird on May 16, 1958. It was the call note that attracted my attention. It was a rapidly uttered, thoroughly unmetallic *kwirri-rr-rr-rr-rr* repeated 6 or 7 times running every few minutes. On the 16th I was able to watch the birds, a pair, from a distance of 45-50 feet. The triangular white patch on the back, set off by the surrounding black, makes the appearance of the bird distinctive. There is no danger of any/one familiar with the commoner woodpeckers mistaking the call note of this bird for that of the Goldenbacked (*Brachypternus benghalensis*) which is the common woodpecker of the area. The pair seen on 16-5-58 spent a few hours in a mango tope and visited a number of coconut and palmyra palms also. The bird was again noted on 23-5-58 and 5-6-58. On the last date I saw only one bird. But it uttered its notes regularly. At dusk it was going up a palmyra tree standing in the midst of fields.

GOVERNMENT COLLEGE,
CHITTUR, COCHIN,
KERALA STATE,
June 5, 1958.

K. K. NEELAKANTAN

8. THE VOICE OF THE KORA, *GALLICREX CINEREA* (GMELIN)

Very little seems to be on record about the voice of the Kora. The best account I have come across is in THE BIRDS OF BURMA, Smythies (1953), where he writes: 'The call or challenge of the male is a deep boom — *ogh-ogh-ogh* — uttered rapidly. When calling the neck is puffed out and the bill pointed vertically down; at intervals it is lowered out of sight and the note changes, sounding exactly as if the bird were blowing into the water (whether it actually does so has not been observed). Another common call, made by bending the neck forward, opening the bill, and working the throat, resembled the popping of corks. . .'

I should like to supplement the above with an account based on half an hour's observation under ideal conditions.

I have seen the Kora in Palghat only on two occasions. On 24 June 1957, at 9.30 a.m., I saw a male walking sedately along a field bund. It was dull blackish brown all over with long, brownish streaks on the wings. It had a fully developed comb. The tip of the comb and the part over the bill were red, the rest of the appendage being yellowish.

On 19 August 1957, at about 5.45 p.m., I was crossing the same stretch of paddy fields when I heard loud clucking calls. It was a male Kora, all black, with the comb and wattle red all over. The bird was on a low bund some 20 to 30 feet away from another bund which is regularly used as a foot-path. Though the bird was surrounded by full-grown paddy, from one point on the foot-path it could be seen very clearly. I stood there for a quarter of an hour fully exposed to the bird's view, but it either failed to notice me or ignored my presence. It seemed intent only on producing the loud call-notes which had first drawn my attention to it.

The notes uttered were chiefly of 3 sorts which had all a remote suggestion of 'booming'. They were produced almost incessantly and there was a definite rhythm about them. The posture of the bird and the nature of the sounds produced had an obvious relationship.

After finishing a series of call-notes, the Kora remained silent for a few seconds. At that time it invariably had its head raised. Keeping the head up, it uttered a series of 10 or 12 *kok-kok-kok-kok* calls, somewhat like the booming notes of the Chestnut Bittern; then, suddenly, it lowered its head with a steep bow and produced a number of deeper, hollower and metallic notes: '*utumb-utumb-utumb*' (*u* as in put). These notes were uttered with greater rapidity than the *kok-kok-kok* calls. The *utumb* sound was very like that produced when a stone, the size of a lemon, is dropped into a deep well. If this is the sound referred to by Smythies, my opinion is that the bird does not lower its bill into water. On the day I saw it calling, the bird was on a field-bund, and could not have dipped its bill into the water.

After 10 to 12 '*utumb*'s, the Kora lifted up its head and resumed the *kok-kok-kok* calls. In between, as the head came up, a series of *kluck-kluck-kluck*'s was produced. I think their number was only 5 or 6 at the most.

As the bird had begun calling in this manner some time before I reached the spot, and continued to do so for another 15 minutes or more, I think it must have called without pause for half an hour at least.

No other Kora was seen or heard at that time anywhere in the area, nor did the behaviour of this bird suggest that he was expecting a rival to show up. At night on the 19th, whenever I listened, I could hear its notes. (My house was 300 to 400 yards away from the spot where the bird was seen.) It was heard at night regularly for a few days thereafter, but was not heard at all during or after the first week of September. By the middle of September most of the fields near my house had been reaped and the Kora could have found little shelter anywhere in the area.

GOVERNMENT COLLEGE,
CHITTUR, COCHIN,
KERALA STATE,
June 5, 1958.

K. K. NEELAKANTAN

[H. G. Deignan in 'Birds of Northern Thailand' (*Bull. Smithsonian Inst.* No. 186 p. 108—1945) says: 'The bird with swollen neck and bill pointed at the ground uttered a series of short notes *owgh-owgh-owgh*, then dipping the head continued with a hollow-sounding *gook-gook-gook-gook*, the tones exactly like that of *Botaurus*. At times the two kinds of calls were interspersed, and without exception the head was lowered to produce the second sound'.—EDS.]

9. PHOTOGRAPHING THE LESSER FLORICAN, *SYPHEOTIDES INDICA* (MILLER), AT NEST

(*With three plates*)

The Lesser Florican is a monsoon breeding visitor to Kathiawar and arrives with the first rains. As soon as I got news of a florican's nest in a grass *veedi* some miles away, I went there with my hide. The nest was in the middle of the thick growth of grass which covered the *veedi*. I put up the hide about 12 feet from the nest and bent down the grass in front so as to enable photographs to be taken. As the road was very bad I did not wish to come here again, and decided to take the risk of attempting to photograph immediately.

The female florican arrived a short while after my helper had left me in the hide and returned to the car. On seeing the lens she at once adopted an aggressive pose and advanced close up; in fact she was not more than a foot from the hide and I was unable to take photographs with my tele lens. After this display she went back to the nest and started pushing the eggs, one by one, back into the thick cover. When all the eggs were removed she started incubating them.

As I wished to take photographs of the bird incubating, I signalled to my helper to come over, and asked him to place the eggs in their former position in the open. Immediately he left the bird returned and again removed them into the grass. By this time it was getting late, so I signalled to my helper a second time to come over and move the eggs into the open. The bird did not remove them again but settled down and started incubating, and I did get the pictures I wanted.

I have noticed this habit of rolling the eggs into the cover also with other floricans that I have photographed.

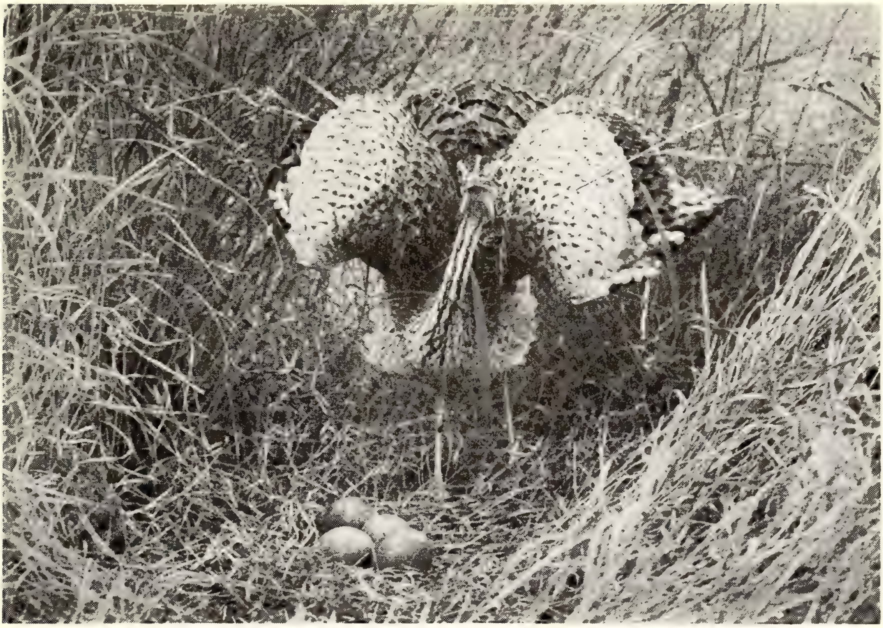
JASDAN, M. K. SHIVRAJKUMAR
July 9, 1958.

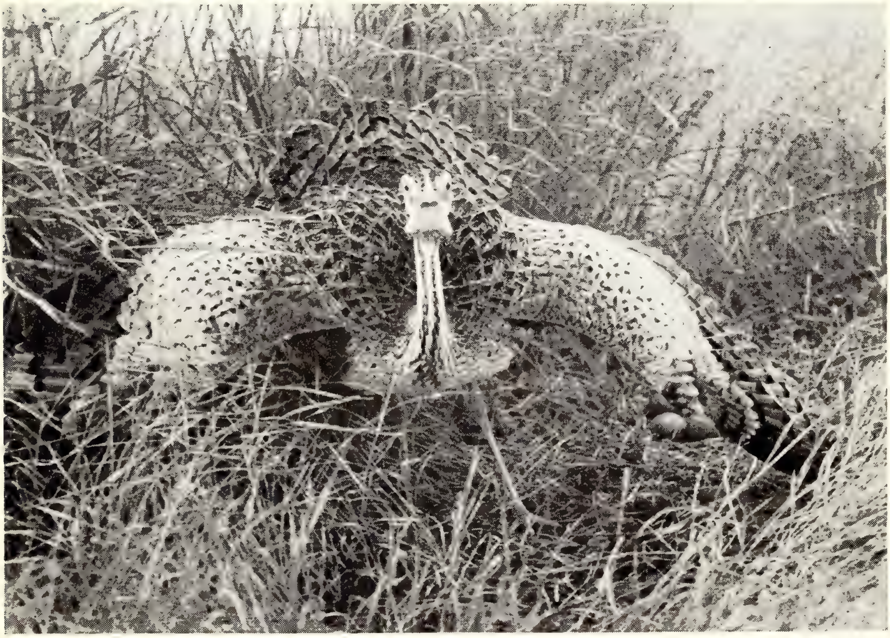
10. WILSON'S STORM PETREL, *OCEANITES OCEANICUS* (KUHL), AT COLOMBO

Since the compilation of scattered records of observations of Wilson's Storm Petrel in seas to the north of its breeding grounds by Roberts (1940), Gibson-Hill (1948), Serventy (1952), and others, a fairly complete picture has been obtained of the seasonal movements of this bird. From observations in the Indian Ocean and Arabian Sea, it appears, as Gibson-Hill (1948) has stated, that 'Wilson's Petrel is plentiful in the area comprising the western portion of the Arabian Sea, the Gulf of Aden and the southern half of the Red Sea, from June to September, and apparently absent from the southern half of the Indian Ocean'.

These areas, particularly the Gulf of Aden, are becoming increasingly well documented by reports from various voyagers, but

LESSER FLORICAN (FEMALE)

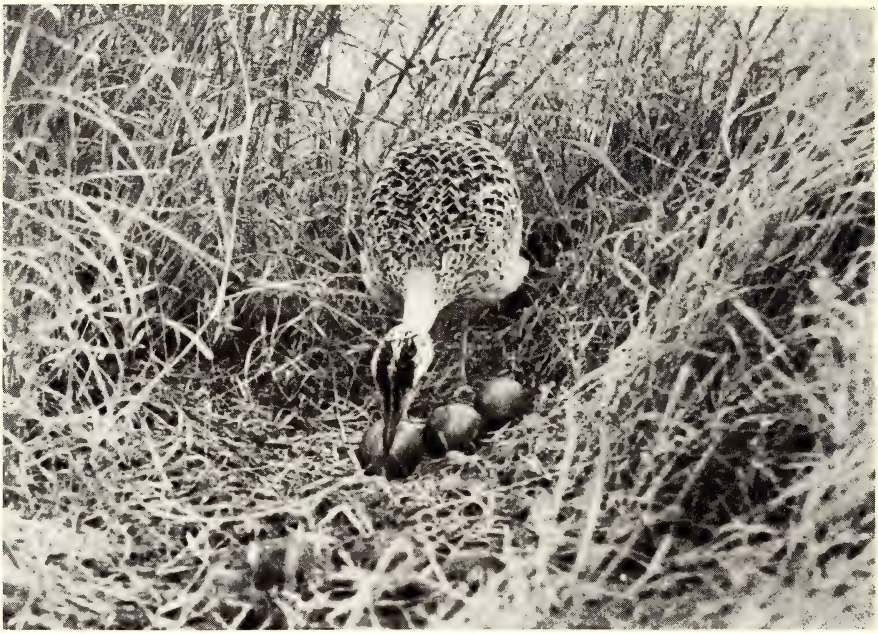


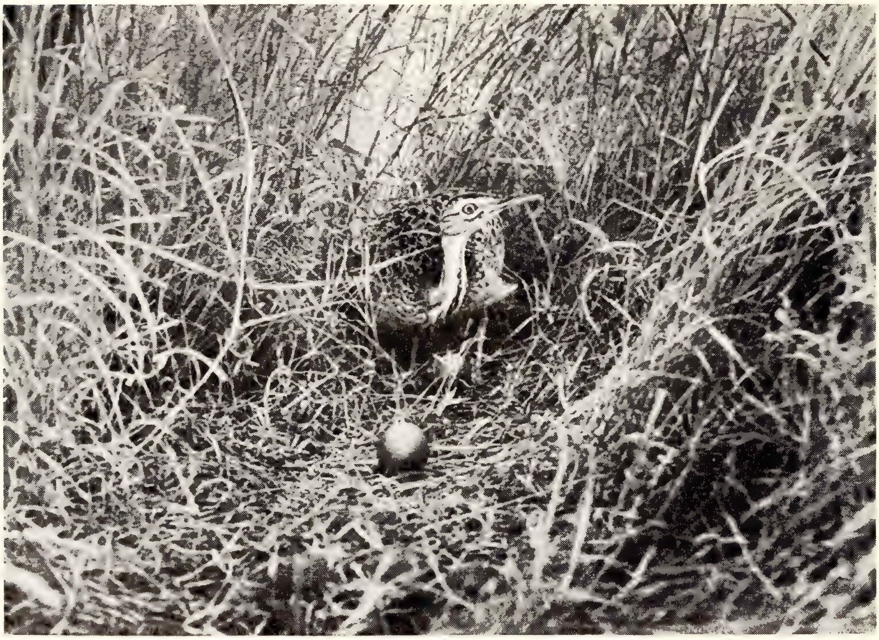


"On seeing the lens she at once adopted an aggressive pose and advanced close up...."

Photos : M. K. Shivrajkumar

LESSER FLORICAN (FEMALE)

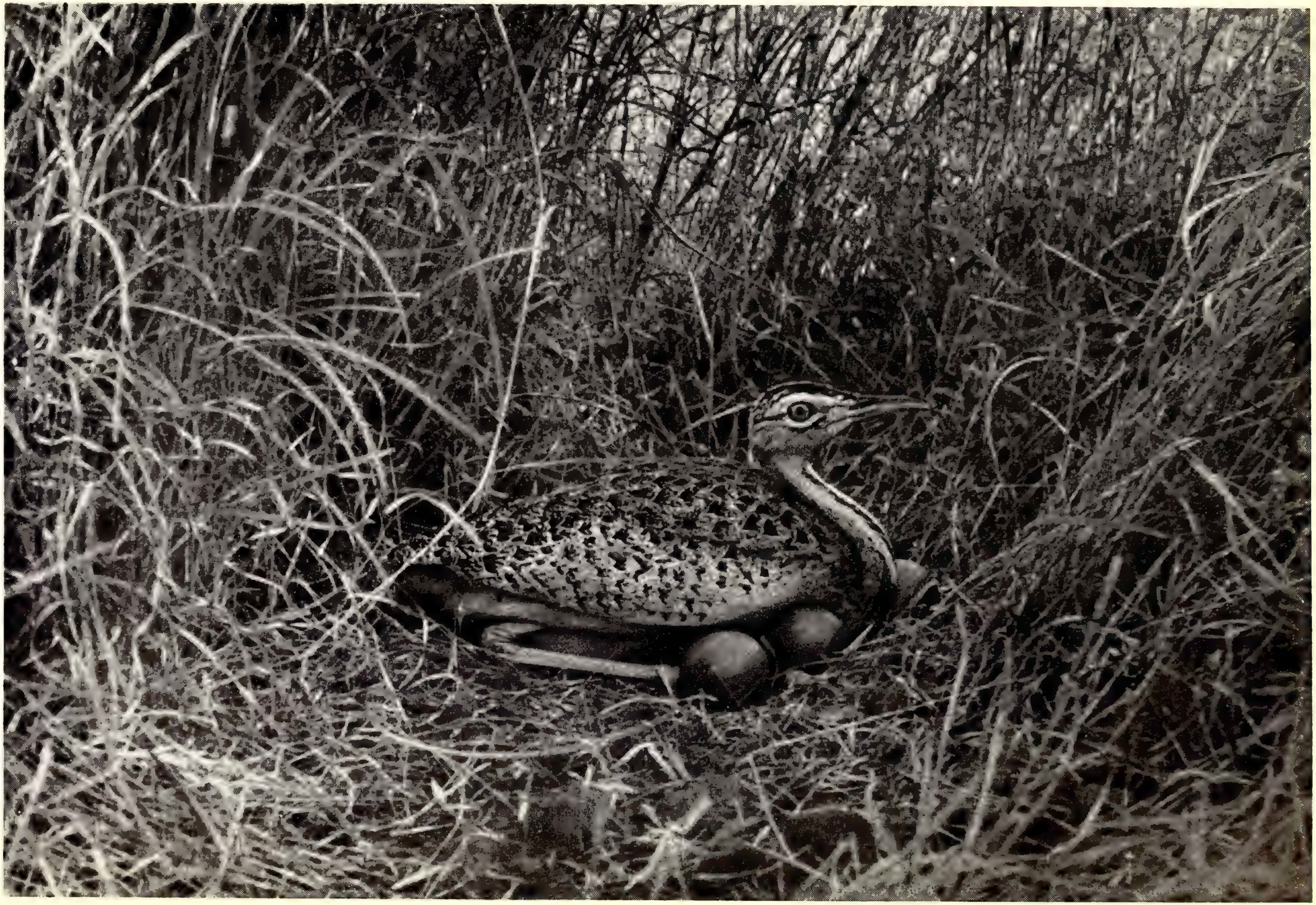




"After this display she went back to the nest and started pushing the eggs, one by one, back into the thick cover."

Photos : M. K. Shivrajkumar

LESSER FLORICAN (FEMALE)



"When all the eggs were removed she started incubating them."

Photo : M. K. Shivrajkumar

there is still a paucity of records from the coasts of Ceylon. This region is of interest since Gibson-Hill (1948: 445) has been led to the conclusion that 'probably the main mass of birds reaches the neighbourhood of Socotra and the Arabian coast in May and June, and moves south by way of the waters off Ceylon in September and November'.

Gibson-Hill (1953: 89) was able to give only three 'formal records' of Wilson's Petrel in waters close to Colombo, these being for November 1908, July 1909, and October 1930. Other records, mentioned earlier by him (1948: 444), were of one bird seen near the entrance to Colombo harbour on 14 October 1946 by E. H. Bromley, and of birds 'probably of this species' seen by Legge in August 1874. More recently, Phillips (1955: 132) has reported the observations made by Mr. G. N. Grisenthwaite from the trawler 'Braconglen' in waters between Colombo and Cape Comorin, across the Gulf of Mannar, from November 1953 to November 1954. From these observations it seems that 'Wilson's Petrels . . . arrive in Indo-Ceylon waters during the last week in May . . . and . . . remain . . . chiefly in the shallower coastal areas . . . for approximately six months . . . and fly southwards . . . leaving Indo-Ceylon waters generally during the first or second week of November.' (Phillips, 1955: 133).

The purpose of the present note is to place on record that on 27 August 1955, while the S.S. 'Otranto' in which I was travelling was off the entrance to Colombo Harbour, I saw very large flocks of Wilson's Petrel close to the ship and extending westward for a considerable distance. I am unable to give any numerical estimate of these birds, but I would suggest that the flocks included several thousand birds. At the time I did not realise that this region was not so well documented as that near Aden, but my impression of these petrels was almost identical with that of Mr. Grisenthwaite in 1954: 'I was immediately impressed by the large numbers of Wilson's Petrel present; just clear of the harbour they were like flies.' (Phillips, 1955: 132). From Colombo, which we left on 28th August, to Aden very few birds of any kind were seen although, with the conditions of the sea and the general visibility, Wilson's Petrel would probably not easily have been overlooked. The noon sea temperatures and wind conditions during these days were as follows: 28 August 84°, SW. 3-4, moderate sea; 29 August 84°, SW. 3-4, moderate; 30 August 81°, WSW. 5-6, rough; 31 August 76°, WSW. 5-6, rough; 1 September 87°, W. 3, moderate; 2 September arrived at Aden.

Sewell (1955: 190) has summarised the meteorological conditions prevailing in the northern part of the Indian Ocean throughout the year: December to February is characterised by winds blowing 'almost continuously from the north-east . . . constituting the North-east Monsoon; in March to May the winds are variable; from June to August the wind blows with considerable force from the south-west, constituting the South-west Monsoon; and in September to November conditions are again variable.' From Phillips's (1955) account, it appears, then, that Wilson's Petrel arrives in Indo-Ceylon waters during the period of variable winds at the close of the North-east Monsoon, and leaves again in a period of variable winds towards the beginning of the South-west Monsoon.

Murphy (1936), followed by others such as Gordon (1955), has shown clearly that a quantitative correlation may be made between meteorological and oceanographic conditions and the distribution of pelagic birds. Quite a lot is known about the spatial limits of the monsoons in the Indian Ocean and the oceanography has been well summarised in Schott's account (1935) where charts of the wind and water movements from February to March (Pl. XXIX, and see Sewell, fig. 1) and from August to September (Pl. XXX, and Sewell, fig. 2) are presented.

Further observation on Wilson's Petrel, particularly from waters east of Ceylon towards the coast of Sumatra are needed, and, when this region becomes as well known ornithologically as the Arabian Sea, some interesting correlations with the oceanographic conditions may doubtless be expected. Voyagers between Indo-Ceylon waters and the Malay Peninsula are in a favourable position to make worthwhile contributions to fill this gap, and such information will be welcome to all those concerned both with oceanography and with sea birds. Gibson-Hill's paper of 1948 may be referred to as an aid to the identification of small petrels likely to be seen in these waters.

N. Z. OCEANOGRAPHIC INSTITUTE,
P. O. BOX 8009,
WELLINGTON,
NEW ZEALAND,
May 1, 1958.

E. W. DAWSON

[Attention may be drawn to the note by Mr. Humayun Abdulali (1948, *JBNHS* **47**: 550) on this petrel outside Bombay Harbour in the third week of October, and to some previously published records of its occurrence in the eastern Arabian Sea, in the editorial comment thereto.—EDS.]

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11. PHOTOGRAPHING A COLONY OF EGRETS (*BUBULCUS IBIS* AND *EGRETTA GARZETTA*) IN ASSAM

(*With a plate*)

The ubiquitous egret must often be viewed by many people as a mere 'accessory' to grazing cattle or to the country's limitless paddy fields. Few of us can have had the opportunity (? or, the inclination) of observing these birds at close quarters. In fact, I myself would have missed such an opportunity had not a sizeable colony of both species of egret, decided to breed this year within half a mile of my bungalow. I felt 'duty bound' both to the Society, and my camera, to attempt to photograph what I was later to discover, were beautiful and fascinating subjects.

In his breeding plumage the Cattle Egret, when seen close to, is transformed into a bird of real beauty—the black legs, the pure white of the wings, the magnificent russet-brown of the neck and breast, and the yellow beak and eye yield a study that is really worthy of colour film. However, in these days of curtailed imports one has little choice with photographic material but this does have the salutary effect (or should have!) of stopping the 'one for luck' attitude of which so many photographers appear to be guilty—the writer included.

The accompanying illustrations were taken with a Leica camera, fitted with a 200 mm. telephoto lens, using Kodak Tri-X film exposed at 1/500th sec. at an apperture of f5.6 to f8. The camera was steadied by one of the supports of the machan, as the use of a tripod was prohibited by the great number of nests, at all angles, which surrounded the hide at ranges from ten feet upwards.

Although one tends to associate the egret with open country the nesting site for this particular colony was immediately adjacent to the local cinema—a more inappropriate and unsalubrious place for the rearing of young would be difficult to find even within a radius of twenty miles. I was unable to establish whether the birds have regularly used this site (as I believe both species tend to do), but this habit would seem to offer the only logical explanation for their strange choice.

The nests themselves were situated in clumps of bamboo which extended over an area of some one and a half acres. The population must have been about five hundred pairs with the Cattle Egret representing at least eighty per cent. Perhaps, conscious of their superior grace and elegance, the Little Egrets kept aloof from their counterparts, but they did not form a separate colony. Their nests, however, were identical as was the incubation period—some fifteen to twenty days with the eggs laid, in this instance, at the beginning of June. The incubating appeared to be the prerogative of the female in both cases[1] although the male of the Little Egret assisted in the building of the nest. Unfortunately, I was unable to observe whether both partners shared in feeding the young.

The Little Egret may lack a diversity of colour in its breeding plumage but exquisite 'aigrettes' render it a singularly worthwhile subject although difficult, as the plumes are shown to their best advantage only when the bird is alighting or in the act of flying. That the export of the 'aigrette' feathers is now banned is, to my mind, a sensible step in the right direction; for not only do these birds considerably assist the farmer, but also they adorn the paddy fields (which often require a relief from monotony) to an infinitely greater degree than their feathers do a woman's hat—which they usually don't!

It is so easy to take nature for granted that it isn't until one has a chance for a closer look that the beauty, variety, and charm of the commonplace are revealed. After photographing these egrets I have derived considerable enjoyment from observing other 'common' birds which, hitherto, I had considered to be merely a part of the countryside and, therefore, hardly worthy of a second glance. I hope, sincerely, that some readers may have a similar opportunity.

SYCOTTA T.E.,
KHARIKATIA P.O.,
ASSAM,
September 9, 1958.

J. H. BURNETT

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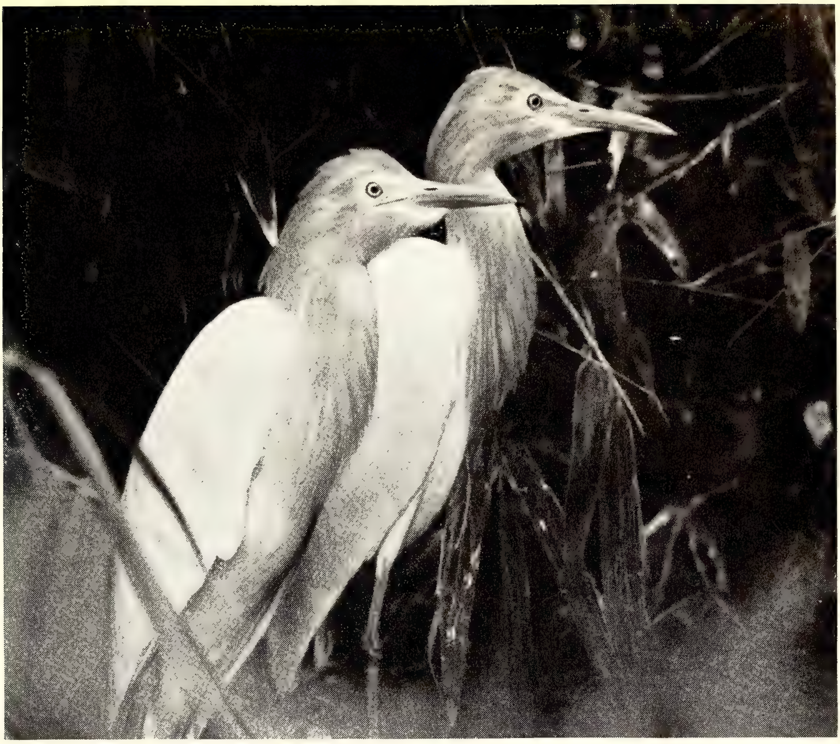
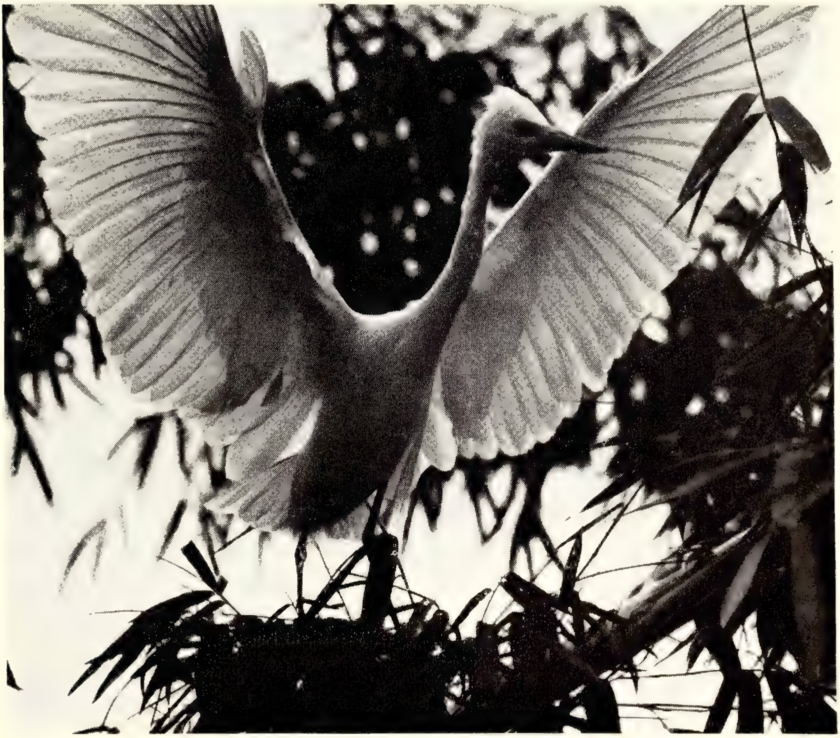
[1] Actually, both sexes take part in incubation and feeding the young.—EDS.



A pair of Cattle Egrets in breeding plumage, Sibsagar Dist., Assam



A Little Egret about to leave its nest, Sibsagar Dist., Assam

Photos : J. H. Burnett

12. NOTES ON THE NESTING OF THE BLACKNAPED TERN, *STERNA SUMATRANA MATHEWSI* STRESEMANN, IN THE MALDIVE ISLANDS

Although I had met with the Blacknaped Tern in North Malé Atoll (*JBNHS* **55** (2): 211) where it is the most plentiful of the nine species of terns that are known to occur, I had not had the opportunity of studying the breeding of the species until I discovered several small nesting colonies in Addu Atoll, the most southernly atoll of the Maldivian Archipelago, during the month of June 1958.

On 2 June 1958 while passing a channel-marking pillar off the inner reef of Hittadu Island in Addu Atoll, I observed a pair of these terns mating on the top of the pillar. Enquiries showed that they were believed to lay their eggs, during May and June, on an uninhabited islet on the outer reef some 5 miles to the north. So I arranged to visit the place the next day.

Starting early in the afternoon, with very little wind, we rowed and sailed over to Bushy Island or Kanda Hera, an islet on the outer reef some 5 miles north-west of Gan Island, where we were living at the time. As we approached close to the islet which was scarcely more than a large coral bank clothed with scrub, dense in places but cleared and planted with a few coco-nut palms in the centre, the terns began to rise from the beaches and fly out to meet us. Circling the boat with continuous cries, in the manner usual to nesting terns when demonstrating their annoyance and concern at intrusion, they kept up a constant babel although their cries were less harsh and raucous than those of other species of colonial nesting terns that I had studied.

The colony was not a large one; I would estimate it at not more than 30 to 40 pairs. The eggs were not easy to find; they were scattered over the raised beaches, some 4 or 5 feet above the high water mark and 5 to 15 feet from the tide line, but they were not all laid close together or in one or two adjacent areas. On the contrary, one gained the impression that each pair had endeavoured to keep as far away as possible from other nesting pairs.

There were no nests. The eggs were laid either on the bare coral shingle, between small lumps of broken coral, or in shallow scrapes which appeared to have been formed by the birds setting down to brood the eggs, rather than intentionally. The eggs blended extremely well with their background of weathered grey coral shingle and sand, and were difficult to distinguish. 14 clutches were counted: 7 contained single eggs and 7 were of c/2 each. Possibly some of the single eggs represented half clutches, but two that were broken by boatmen's feet were both incubated. Fourteen eggs were measured: they averaged 39.4 mm. × 27.44 mm. (38 to 44 mm. × 26 to 29 mm.).

In all eggs, except one, the ground colour was a light stone-grey, matching well the grey of the weathered coral on which they were laid. In the single exception, the ground colour had a distinct brown tinge. All eggs were typical 'terns' eggs', the markings consisting of spots, speckles, and blotches of sepia to light brown, overlaying smudges and faint blotches of purplish grey or lavender. Some eggs were considerably more heavily marked than others and some were more distinctly spotted than others. In several, the spotting and speckling was well distributed over the whole surface, with one or two hair-lines at the larger end; in others there was a well-defined zone of sepia blotches either midway round the egg or towards the larger end, while in three eggs there were large, dark brown blotches measuring up to 21 × 17 mm. and others of pale bluish grey. Apparently, blotches, when present, may be anywhere on the surface of the egg but usually they are towards the larger end.

An abnormally shaped egg, measuring 44 × 26 mm., was more or less unmarked at the smaller end but had a well-defined zone, round the larger, of underlying purplish grey with large and small spots of dark brown and purplish brown superimposed; elsewhere there were a few spots and faint smudges of sepia.

Leaving Bushy Island, we visited two other tiny coral islets on the outer reef—mere outcrops or flat biscuits, only a few feet above high water, with much broken coral-shingle thrown up on them by storms. Although over the first a few Blacknaped Terns were flying and demonstrated their annoyance at our intrusion, no eggs could be discovered; but on the second, which was rather the smaller, six pairs of c/2 were found after considerable searching. Again they were not all close together in one sector of the islet but were spread apart, with several yards between clutches.

Except that all eggs were in clutches of two, no differences were noted between this and the Bushy Island colony, distant about half a mile to the north. It was estimated that this colony numbered not more than 20 pairs.

A third nesting-colony was discovered on 13th June on a tiny storm-piled bank of broken cora shingle thrown up on the main outer reef on the south-western side of Gan Island (Addu Atoll). A few terns were visible, with the aid of field glasses, circling the islet from time to time so I waded out to investigate. As usual, as I approached, a number of Blacknaped Terns flew out to meet me and register their protests at my coming. At first, I could find nothing to justify their concern but after a more intensive search and the watching of some of them as they alighted, I was eventually able to find three clutches c/2, c/1, and 4/1. It was evident that the members of this colony were only just commencing to lay and some of them were still engaged in choosing egg-sites.

Again there were no attempts at nests, the eggs in every case being laid on the bare coral sand, in very slight scrapes or, more truly, in smoothed circles of 1½ to 2 inches in diameter. The eggs themselves were very similar to those of the other two colonies.

The general breeding behaviour of the Blacknaped Tern, when nesting, appears to conform very closely to the normal behaviour pattern of the Sternidae; numbers fly out to meet the intruder on his approach to the breeding territory, circle screaming overhead throughout his stay, and quickly resettle themselves on their eggs or alight on coral knobs on his withdrawal. The voice of this tern is, however, less loud and harsh than in the majority of the family.

c/o R.A.F. Gan,
c/o Air Movements,
Katunayake,
Ceylon,
August 8, 1958.

W. W. A. PHILLIPS

[The overall breeding range of the species *Sterna sumatrana* Raffles is islands in the Indian Ocean and western Pacific, north to the China Sea, south to New Caledonia. Within Indian limits the typical race (Burma, Malaysia) breeds in the Andaman and Nicobar Islands. The range of the race *mathewsi* (described from the Aldabra Islands north of Madagascar) is given as islands of the western Indian Ocean from the Seychelles, Amirante and Aldabra Islands, east to the Chagos Islands. The race occurring in the Maldives had remained undetermined until specimens were collected recently by Major Phillips (*JBNHS* **55**: 211).—Eds.]

13. THE PRESENT STATUS OF THE WHITEWINGED WOOD DUCK, *CAIRINA SCUTULATA* (S. MÜLLER)

(*With a plate*)

At its inaugural session at Mysore in 1952, the Indian Board for Wild Life placed two ducks of north-east India on the special Protected List. These two were the Pinkheaded Duck (*Rhodonessa caryophyllacea*) and the Whitewinged Wood Duck (*Cairina scutulata*).

Even at that time it was feared that the Pinkheaded Duck, of which there has been no really authentic report for a number of years, had become extinct.

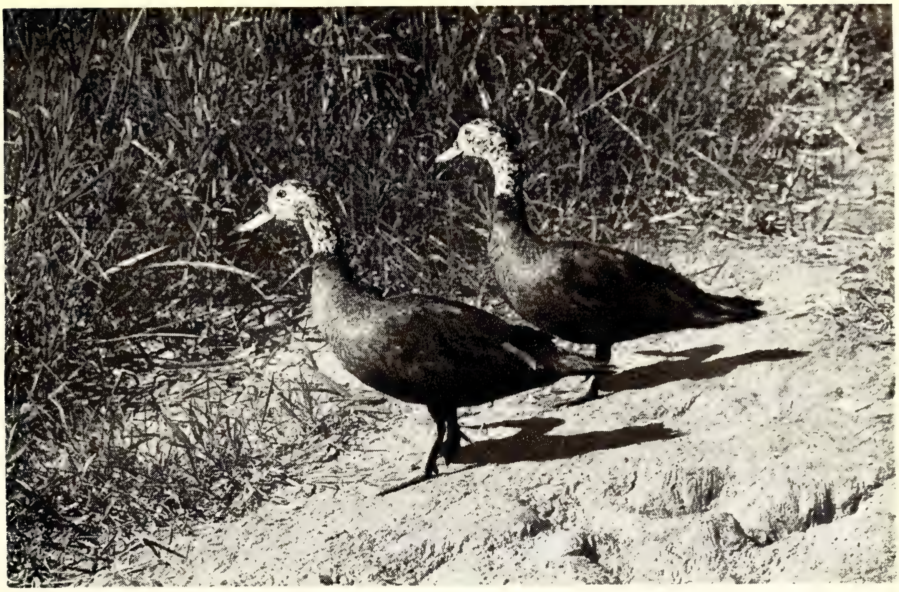
What of the status of the Whitewinged Wood Duck? I have been trying to collect information on this interesting bird which appears to be found only in Assam (as far as India is concerned), Burma, Malaya, and Indonesia. In Assam it is rarer in the districts of Goalpara, Kamrup, and Darrang; less rare in parts of Nowgong and Sibsagar; and more frequently found in Lakhimpur and Luhit Frontier Division (Sadiya), and possibly Cachar. For field identification it is a black and dark brown duck of large size, with spotted black and white neck, and with conspicuous white patches on the wings. It is not to be confused with the Nukta or Comb Duck (*Sarkidiornis melanotos*) of which the body is white below and of which the drake has a conspicuous knob or comb at the base of its bill.

A resident and non-migratory species, the Whitewinged Wood Duck frequents patches of water and long still pools of rivers in thick forests away from human habitation, especially near the foothills. Sometimes they are found in small parties of about six or less, but usually they go about singly or in pairs. During the heat of the day they generally remain in the shade of a tree, either on the water or on a branch. Therefore early morning and evening are the times when they are to be seen.

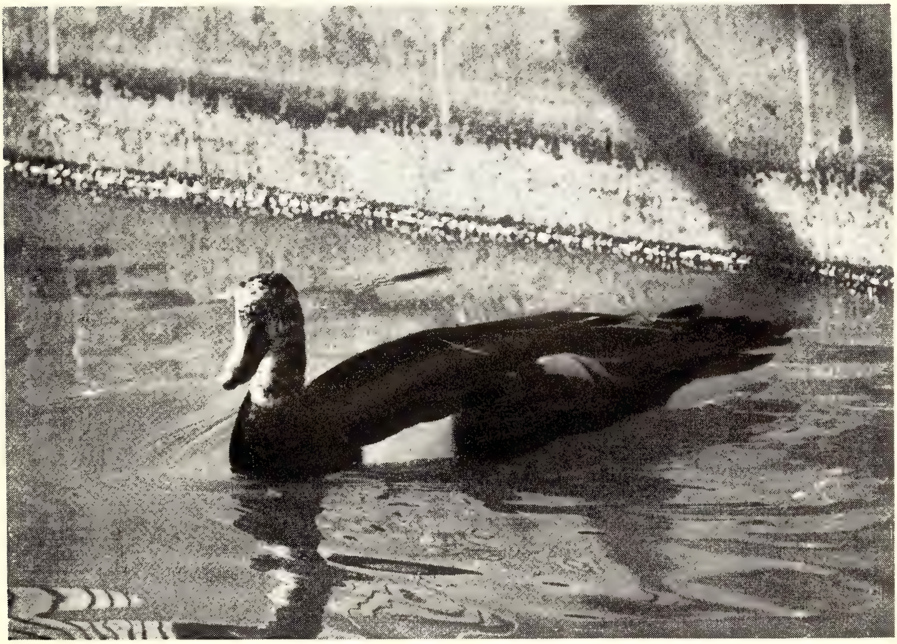
They nest in trees, either in holes of trees, or in large nests of sticks and rubbish in a fork of a tree or in a mass of branches. May to August is believed to be the time that breeding takes place. Some people say that these birds make a nest of grass etc. in scrub-jungle near water.

In 1913 J. C. Higgins mentioned this duck as being common in Upper Chindwin District of Burma, and comparatively so in Upper Assam. He saw three of them in Manipur on one occasion only. In 1915 H. Stevens met this duck near the Dibru River in Lakhimpur District, and near the Dejoo River in North Lakhimpur, and reported its call as being an unmistakable long drawn 'honk'.

Stuart Baker recorded in 1921 that he had found a great many of these ducks in Sadiya, and reported their presence in fair numbers in parts of Lakhimpur District, and refers to a few which had been seen or shot in other parts of Assam. In 1947 Sálim Ali and Dillon Ripley wrote: 'A pair were seen at Tezu and near Brahmakund in January. They haunt the jungle-grown streams and do not usually come out on to the broad gravel banks of the Lohit'.



Whitewinged Wood Ducks in captivity, about four months old



Adult bird in Alipore Zoological Garden, Calcutta

Photos : E. P. Gee

Early in 1956 I drew up and sent out a questionnaire (given at the end of this note) on the Whitewinged Wood Duck to a number of Forest Officers and tea planter sportsmen in order to find out the present status of this rare and interesting bird. I am grateful to the following persons who responded to this questionnaire and supplied me with interesting information: Frank Nicholls, H. K. Dodwell, J. R. Clayton, C. G. Allen, E. D. Hooper, C. D. Hopper, and the Director of Forests, N.E.F.A.

A pair or two of these ducks are reported to be now resident in the Behali Reserved Forest in the north of Darrang District. In the *bheels* and other pieces of water of the Ranga Reserved Forest, west of North Lakhimpur town, there are a few pairs. A fair number exist in the Phillobari area east of Doom Dooma town. They are to be found in all the streams running through the Dibru Reserved Forest. Occasionally a single bird or a pair is found in the forest near Digboi. I myself recently saw a pair on a long still pool of the Kaliani River in the Mikir Hills.

Though no news is at present available from many parts of north-east Assam and Cachar and though the little information available is sketchy, what has been found out so far is not altogether discouraging. Much more information is required from many more people, after which it will be possible to draw a more complete picture of the situation. The consensus of opinion of my informants so far is that this duck has become much rarer than it was fifteen to twenty years ago, chiefly due to its habitat gradually becoming opened up by deforestation and cultivation.

The Whitewinged Wood Duck appears generally to roost during the heat of the day on shady branches of trees low down near the water, coming out to feed in the evening and feeding all night. It is seen sometimes in the early morning before it retires. When encountered on the water, it is not particularly wary. In fact some correspondents consider it 'foolishly unwary'. It advertises its approach when flying and its presence when feeding by its loudly repeated call.

As to their enemies, apart from man with his deforestation and extending cultivation, Frank Nicholls reports that he has personally twice seen these ducks attacked by hawks while flying. One, he says, was actually struck down into the reeds, but later managed to fly away. This correspondent has also seen a large water monitor (*Varanus salvator*) swimming about in a *bheel* frequented by Whitewinged Wood Duck, and actually saw this lizard take a moorhen and even attack a cormorant.

I find that many people, even sportsmen who shoot regularly, are not aware of the identity of this duck. Although it is clearly stated in gun licences in Assam that the Pinkheaded Duck and the Whitewinged Wood Duck are closed to shooting for the whole year and although it is not good eating, people shoot it or at it without knowing that it is a fully protected bird. This proves the need for wide publicity about this rare and vanishing species, so that everyone including the villagers in the forests will be able to assist in protecting it.

In my paper 'The Function of Zoological Gardens in the Preservation of Wild Life' [*JBNHS* **53** (1): 84] I wrote: 'The Whitewinged Wood Duck of north-east India, recently placed by the Indian Board for Wild Life on the list of birds proposed to be totally protected, is known to thrive in captivity: here is another opportunity of saving from extermination a species before it goes the way of the Pinkheaded Duck'. I am convinced that an effort should be made to keep and breed this duck in captivity in India.

I note that Stuart Baker in his INDIAN DUCKS AND THEIR ALLIES states: 'They are charming birds in captivity, and are tamed without the slightest difficulty. When the breeding season approaches, they, if not confined or pinioned, fly away; but throughout the cold weather months they may be allowed to wander about at their own discretion, and will always keep near home if regularly fed. When thus domesticated it is a curious fact that they never seem to use their wings as a means of locomotion, but will walk very long distances to and from water. A duck belonging to a planter whose house was nearly half a mile from water invariably *walked* there and back every evening, returning to the house for the hot hours of the day and for the night. This particular duck was the object of a wild infatuation on the part of a small domestic drake, who followed her about wherever she went, and as the Wood Duck could walk at, at least, thrice the rate the drake could, he eventually succumbed to sheer exhaustion and want of time to feed in. She, however, totally ignored all his advances, and in April flew away to find a wild mate.

'They are very impatient of heat, and the birds in my aviary always retired indoors as soon as the sun was up, and even in the cold weather they always kept under cover from 10 a.m. to 2 p.m. Those I sent down to the Calcutta Zoo died very quickly, except one fine drake, who lived about eighteen months before dying of the same disease which carried off the rest—an affection of the stomach.

'My birds were practically omnivorous, but would touch no dead animal food. Every other day a pail-full of small fishes was emptied into their tank, and by nightfall these were generally all accounted for; but any that died during this period were never eaten. In the same way, worms that ceased to struggle were discarded, and grasshoppers, frogs and snails would only be taken if alive.

'They ate paddy and husked rice freely, and I have kept birds for some weeks on this alone, and they kept fat and well upon it, but, at the same time, when they were offered animal food they preferred it to the grain. Green food of all sorts they refused unless very hungry, and I could never induce them to eat any sort of water weed, though one would expect them to eat such in a wild state.

'They were extremely expert in catching fish; as a rule, they skimmed along the top of the water with the head and neck immersed, but when necessary would dive and chase the fish under water. Of course, their speed when doing so was not comparable to that of cormorants, or the diving ducks under the same circumstances, but it was sufficient to ensure the capture of almost any fish. They are very mild, well-behaved birds, and not, as a class, at all quarrelsome. Some tiny whistling teal shared their captivity, and were always treated with consideration and allowed their share of food, etc. As already said, they very soon become tame, and within a few weeks they were all tame enough to accept food from the hands of those they knew well; but generally when strangers appeared they retired to their inner room. When not feeding, they almost invariably sat on the perches and not on the ground, and they showed considerable activity in turning about on them; at the same time they kept their position almost entirely by balance and not grasp, as anything touching them at once upset them.'

Peter Scott, Honorary Director of the Severn Wildfowl Trust in Britain, wrote to me in September 1956 of the Whitewinged Wood Duck: 'We already have seven and they seem quite hardy. One lived out in England all through the war. They have not bred in England but a pair bred successfully in Holland in 1938; we are, therefore confidently expecting to breed them. We have only three females.'

Several persons in Assam have succeeded in rearing and keeping these ducks in captivity. From Towkok Mrs. Whyte wrote to me in 1955: 'These birds nest on our golf course every year. We hear their weird call long before we see them flying over the fairway in the late afternoon towards their nest. My husband picked this one up wounded and looked after it until it recovered. By that time it had grown quite tame so he kept it in a *pucca* pool in the compound. For company he put in a Muscovy Duck with it. The pair got on very well together apparently. However, one morning when he looked at them they were perfectly all right, two hours later he found the Wood Duck dead. We both think that the Muscovy was responsible.'

Mrs. Barron informed me in 1955 that at Phillobari some years previously: 'A pair of birds were brought to me from the interior jungle by an Assamese, who told me they were only to be found in the densest jungle beside water. They build their nests off the ground about three to five feet up in tree stumps as far as I could make out. I had box nests made for them about four feet off the ground of their chicken house, in which they seemed very happy. They did not breed. They were very handsome birds and allowed me to stroke and pick them up, and used to swim daily in a little cement pond in the garden'.

In 1956 I myself received a bird from a friend in the Doom Dooma District, and later two more from another friend near Tinsukia. These three did very well in a small *pukri* at the back of my bungalow. Although their wings were clipped they made repeated efforts to fly—not in order to escape (for they had become very tame) but because of their active habits. Once or twice when they did manage to leave the *pukri* and bungalow compound and wander some distance into the tea garden, they came back of their own accord. One of the three was eventually taken by a jackal, and for the safety of the remaining two I presented them to the Alipore Zoological Garden, Calcutta. One has since died, but the other is doing well. If only more birds could be obtained, an effort could be made to breed them.

Here is an excellent opportunity for the newly started State Zoo at Gauhati to construct a suitable pond with plenty of grass cover and thick tree shade all round it, to provide a home and breeding place for this rare and interesting duck of Assam.

The writer is keenly interested in receiving every available piece of information from every source about the Whitewinged Wood Duck. Should any readers of this, or their friends, obtain any information and forward it preferably in the form of answers to the questionnaire, they will be making a valued contribution towards the preservation of India's wild life.

Information wanted on the Whitewinged Wood Duck

1. In what localities are they found, and in what numbers?
2. Are they strictly resident in one place all the year round, or are they locally migratory?
3. Are they in the habit of feeding by day, or by night?
4. Where do they breed, and what sort of nest do they make?
5. When is the breeding season? Are there two broods?
6. Are there any cases of their eggs being taken and put under a domestic bird for hatching, with success?

7. Are there any cases of baby chicks being taken and reared?
8. Are there any cases of adult birds being caught and tamed?
9. Are any of these ducks alive in captivity now?
10. Are there any cases of these ducks breeding in captivity?
11. Are they wary birds, or foolishly unwary?
12. What are the factors working against their survival?
13. Are they becoming rarer year by year?
14. Have you any suggestions for their successful preservation?
15. Have you any other information about these ducks?

N.B. The above information is urgently needed, so that the Whitewinged Wood Duck may be properly protected and not become extinct. If you know of anyone else likely to be able to supply information, could you please pass this questionnaire on to him. All information may be sent to me for compilation for forwarding to the appropriate authority.

DOYANG T.E.,
OATING P.O.
ASSAM,
September 29, 1958.

E. P. GEE
Honorary Regional Secretary,
Eastern Region, Indian Board for Wild Life.

14. MORE BIRD NOTES FROM KUTCH

Since K. S. Lavkumar kindly asked for and sent in some of my notes on bird occurrences in Kutch which appeared in Vol. **54**, No. 1 of this journal, I have been able to record one or two new birds for this area and also to substantiate two of my previous sight records for Kutch. I give these below along with notes, including some already mentioned by K. S. Lavkumar.

Culicicapa ceylonensis (Swainson) : Greyheaded Flycatcher

This bird was first noticed by me at Vijaya Vilas (Mandvi) in January 1948, but at that time I could only catch a fleeting glimpse of the bird. However, on 24th December 1956 I observed at least 3 or 4 birds in the same locality, and I saw them regularly during my stay at Mandvi for about a fortnight. I eventually secured a specimen to be sent to the Bombay Natural History Society. This is the first record of the bird in Kutch.

Chibia hottentotta (Linn.) : Haircrested Drongo

A most unusual occurrence for this part of India. I first came across this bird in January 1948, and I saw it again on 29th December

1956 in the same place, Vijaya Vilas, and I shot the specimen which was later on sent to Mr. Sálim Ali who confirmed my identification. Besides the bird shot by me I saw a second one on the same day which, even after one month when I visited Mandvi again, was still there.

Dicrurus longicaudatus Jerdon: Grey Drongo

R. S. Dharmakumarsinhji was the first to spot this bird at Mandvi in January 1955 in the Vijaya Vilas Palace grounds and one bird was collected by M. K. S. Fatehsinhji which was sent to the B.N.H.S. In subsequent years I have found this bird to be quite a common, and at times numerous, cold weather visitor to places in Kutch where there are shady groves such as are to be found at Sarad Bagh in Bhuj, Vijaya Vilas Palace grounds in Mandvi, etc. I have also come across this species elsewhere in Kutch, but only as stray birds.

Dicrurus caerulescens (Linn.): Whitebellied Drongo.

One bird was seen by me in my own compound in Bhuj near the Jubilee Ground on 1st November 1956. Later on I observed two birds which remained here till 15th March 1957. As far as I know this bird also has not been recorded by anyone in Kutch.

Ciconia ciconia (Linn.): White Stork

I first came across this stork in the Banni during December 1954 when I saw one bird on a shallow lagoon. On 29th January 1955 while out for a houbara shoot I saw one bird on the Rávalpír tank near Mandvi. This bird of course has been recorded by Lester in August 1895, but the Sálim Ali survey failed to come across it in Kutch.

Lobipes lobatus (Linn.): Rednecked Phalarope

Also a first record for Kutch. I observed this bird in May 1948, and then again on 15th May 1949 on Devisar tank which is situated about 10 miles from Bhuj. This may not be a particularly uncommon visitor, since it can be easily overlooked by the uncritical observer.

JUBILEE GROUND,
BHUJ, KUTCH,
April 15, 1958.

M. K. HIMMATSINHJI

15. TRINKET SNAKE (*ELAPHE HELENA*) WITH ABNORMALITIES IN VENTRAL SCALATION

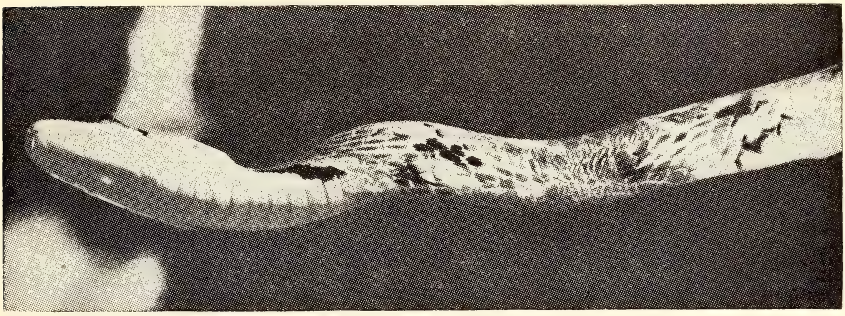
(*With a photo*)

The serpent in question was forwarded to me by the Honorary Secretary, Mr. Humayun Abdulali, for my opinion on the abnormalities noted in the scalation over a length of 40 mm. on the anterior part of the animal.

The following extract from Mr. Abdulali's first letter dated 1st June 1957 explains the circumstances:

'A few days ago a friend brought in a trinket snake (*Elaphe helena*) which he had obtained from a madari or snake-charmer. A few inches behind the head it bore marks of an injury, in the healing of which the ventrals over a distance of about 40 mm. had been completely lost and replaced by small transverse scales!'

The above letter was accompanied by a photograph showing the post-cranial region in a spirally twisted condition, and on the strength of this and assuming that the abnormality was, as suspected, traumatic in origin, I expressed the opinion that repair of a fairly large wound had been effected by contraction of scar tissue which had resulted in dragging down part of the lateral and dorsal scaly skin to close the gap. I did not consider that there had been any new scale-formation. My opinion was shared by my friend, Dr. Angus Bellairs, to whom I submitted the photograph.



Some time afterwards the preserved specimen was sent to me, and on examination I found that the affected area of skin had been partly dissected off. In spreading this out and studying the scalation more critically, I am now of opinion that the abnormality is probably congenital and not due to injury.

We have no positive evidence of the snake being injured. The area affected is such that the injury, if it ever occurred, must have been an extensive one—involving removal of a relatively large slice of skin by the bite of some predator. Such an injury would almost certainly prove fatal as serpents do not recover readily on account of the slow rate of tissue growth, which leaves ample time for attack by parasites, e.g. maggots, or by ants.

Assuming, therefore, that injury had not occurred, we must fall back on the hypothesis of congenital abnormality. This is supported by the scale arrangement. At both extremities of the elliptical abnormal area are transversely disposed ventral scales of transitional size and shape. These are succeeded by small scales arranged in rather irregular transverse rows linking up on each side with normal dorsal type scales. About 19-20 ventrals are replaced by scales of abnormal size and shape. Anteriorly, the transition is less abrupt, especially on the right where five large oblong scales occur in succession, their fellows being represented by small quadrate scales, or, more posteriorly, by oval scales showing tendency to unibrication. In the caudal half of the abnormal area, small oval or quadrate scales replace the ventrals on both sides.

I therefore now consider that the error is due to abnormal development in the embryo, due to some inhibiting factor or local change of the environment of development at the time when the ventrals are being laid down.

THE ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK,
LONDON, N.W. 1,
July 17, 1958.

W. C. OSMAN HILL

16. CAN SNAKES PRODUCE VOCAL SOUNDS?

Some time back the Society received the following letter from Dr. B. K. Behura, Department of Zoology, Ravenshaw College, Cuttack:

'A python (*Python molurus*) measuring about nine feet two and a half inches was kept under captivity by me at the Department of Zoology since May 1954 until its death in September 1957. On 12 April 1957 finding the water-can inside the cage of the reptile empty, I poured a glass of water into the can from above the cage, and to my surprise I heard a distinct 'Umh' resembling the sound of a man in agony. Shri U. C. Panda, a Lecturer of the Department who was standing near the cage also heard the same and we had no doubt that the sound had come from the python in the cage.

'It would be interesting to know whether other snakes also produce sound and the circumstances under which they do so.'

Not far from Bombay on 9 January 1955 I saw a large Dhaman (*Ptyas mucosus*) which, when chased, went into a hole. We caught hold of its tail and after considerable effort, which included some rough handling, pulled it out and carried it to camp where Messrs Sálim Ali and B. Biswas of the Zoological Survey of India were also present. While being carried and for some considerable time afterwards, it uttered several kinds of noises which included a low whine and variations thereon.

Upon receipt of Dr. Behura's letter I wrote to Dr. W. C. Osman Hill, Prosector, Zoological Society of London, whose reply reads in part:

'Our experience here is that no snake produces any sound other than hissing, but the quality and tone of the hiss may be altered by the presence of pathological secretions within the respiratory passages. I think this may be the case with the Python mentioned, which agrees with a record we have for a Boa. But the case of the Dhaman appears unique as this was presumably a healthy animal.

'I am told that in some travel books cases have been cited of Anacondas snoring, but this has never been confirmed by scientists.'

BOMBAY NATURAL HISTORY SOCIETY,
91 WALKESHWAR ROAD, BOMBAY 6,
September 11, 1958.

HUMAYUN ABDULALI

17. LARVAL WATER-MITES (HYDRACARINA) PARASITIC ON INSECTS, WITH NOTES ON THE DISPERSAL OF SMALL FRESHWATER INVERTEBRATES

This paper summarises the previous literature on larval water-mites parasitic on insects and gives records of my observations on this subject with a discussion of the life-history and the direct and indirect effects of the parasite on host insects. The general problem of the dispersal of small freshwater invertebrates by flying animals is reviewed.

There are many recorded instances of larval water-mites parasitising aquatic insects. The adult mites are free-living and carnivorous. They lay eggs on water plants and the six-legged larva which hatches out attaches itself to a variety of aquatic animals. Both vertebrates and invertebrates are hosts to these parasites. They have been reported on the Corixidae (water boatmen) by Soar (1901), Hungerford (1919), Pearse and Walton (1939), Griffith (1945), Lansbury (1955), and Leston (1955). I found them on the corixid species *Sigara lateralis* Leach, *S. dorsalis* Leach, *S. distincta* (Fieb.), *S. fossarum* Leach, *S. nigrolineata* Fieb., and *Hesperocorixa linnei* (Fieb.) [Fernando (1956), unpublished]. They have also been reported from the Notonectidae (backswimmers) by Soar (1901), from the Dytiscidae (diving beetles) by Soar and Williamson (1925), and from the hydrophilid beetle *Helophorus brevipalpis* Bedel by me [Fernando (1956) unpublished]. Carpenter (1928), Ward and Whipple (1945), and Mellanby (1953) refer in general to larval water-mites parasitic on insects.

In Ceylon I have found larval water-mites parasitising aquatic insects on a few occasions. They were found on the water scorpion *Ranatra elongata* Dohrn, taken from a drying up pond in Habarana. Five specimens of this water scorpion were captured and all of them were heavily infested, the mites being attached to the thorax, abdomen, and legs, very often on the soft parts between the chitinous plates of the body. The largest number of mites on a single individual was 16. The slowness of movement of these insects and the fact that the pond was drying up and crowded with insects accounts for the large number of mites. A single larval mite was found on the lower surface of the abdomen of the water strider *Hydrometra vittata* Stal, captured at Nugegoda. In the dytiscid beetle *Eretes sticticus* L., also taken at Habarana with the water scorpions, 5 specimens of a total catch of 16 were infested. Two or three mites were found on a single insect and they were attached to the dorsal surface of the elytra and the underside of the thorax and abdomen.

Larval water-mites are sometimes found on terrestrial insects with aquatic larva. Ward and Whipple refer to this phenomenon in general. Weerekoon (1956) found four larval mites attached to the abdomen of the chironomid fly *Chironomus* (*Chironomous*) *supplicans* (Meigen) taken in an emergence trap. I found a single larval water-mite on the underside of the thorax of the dragonfly *Diplocodes trivialis* Rambur, captured at Nugegoda. Weerekoon (personal communication) suggested that the larval mites probably attached themselves anew after the final moult of the insect larva. It seems more likely however that the shedding of the larval or pupal skin does not remove the larval mite.

The dispersal of freshwater invertebrates by larger animals is a very important phenomenon and results in the spread of the species into isolated bodies of water. I have found water-mites in isolated bodies of water. Boycott (1936) found small bivalves in isolated ponds and considers birds to be the chief agency in their dispersal. He suggested that aquatic insects may be effective over short distances. Charles Darwin in his famous book THE ORIGIN OF SPECIES was the first to focus attention on the importance of larger animals in the dispersal of smaller forms. He believed this phenomenon to be widespread, and recorded two instances one of the freshwater mollusc *Ancylus* carried on the water beetle *Colymbetes,* and the other of a duck carrying freshwater shells on its feet. Kew (1895) published a book on the subject of the dispersal of shells in which he recorded instances of bivalves attached to aquatic insects. Carpenter (1928) discusses the role of insects in the dispersal of Mollusca and Arachnida and suggests that they play an important part in extending the range of species found in ponds and streams. Fernando (1954) recorded bivalves on Corixidae and has summarised the earlier literature on the subject of dispersal of Mollusca by aquatic insects. Weerekoon (1956) suggests that water-mites are dispersed from one body of freshwater to another by insects. Since water-mites are found commonly on aquatic insects which are known to fly from one body of freshwater to another [Fernando (1956) unpublished] these are an effective means of dispersal of the mites.

Leston (1955) records earlier deaths among mite-infested, over-wintering Corixidae in spring. It is likely, however, that the weaker and therefore slower moving of insects are more easily infested in the first instance. The same author mentions that the formation of the dorsal air film in Corixidae is interfered with by the presence of the mites.

Further observation is likely to show that larval water-mites infesting insects is a widespread phenomenon. The larval mite obtains its nourishment from the insect and must therefore cause some harm to it. The extent of this harm is not known. There is no definite evidence that mite infestation increases the mortality of the insects directly. However, indirect effects by hindering the insect in its movement and generally weakening it are likely to result in increased mortality as a result of predation, as has been shown in the case of parasitised fish by Van Dobben (1952). An interesting feature in the life history of these mites is that moulting of the insect larva does not remove the larval mites. Insects play an important part in the dispersal of the mites from one body of freshwater to another as in the case of some other invertebrates.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CEYLON, C. H. FERNANDO
COLOMBO,
February 17, 1958.

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18. ADDITIONS TO THE CRAB FAUNA OF BOMBAY STATE

(*With two plates*)

An account of the Brachyuran fauna of the Bombay coast was given in the previous issues of this journal (Chhapgar, 1957, *JBNHS* **54**: 399-439; 503-549). Collections of the crabs made subsequent to the publication of this report on 'The Marine Crabs (Decapoda: Brachyura) of Bombay State' revealed the occurrence of three new distributional records. A systematic description of these three forms is given below.

Tribe BRACHYGNATHA
Subtribe OXYRHYNCHA

Family *HYMENOSOMIDAE*
Genus **Elamena** Milne-Edwards
Elamena sindensis Alcock

Elamena sindensis, Alcock, *Journ. As. Soc. Bengal* **69**, p. 386 (1900).
Kemp, *Rec. Ind. Mus.* **13,** p. 274 (1917).
Tesch, *Siboga Exped. Rep.* **39** c, p. 24 (1918).
Chopra and Das, *Rec. Ind. Mus.* **32,** pp. 424, 425 (1930).

Four females from Okha are in the present collection. The largest measures:

length of carapace	.. 5. 00 mm.
breadth of carapace	.. 4. 75 mm.

This species can be distinguished by the pyriform carapace with upturned edges, and the triangular front. The tips of the dactyli of the walking legs are triunguiculate.

This species has been previously recorded from Karachi and the Persian Gulf. This is the first record from Bombay State.

Family *MAIIDAE*

Subfamily INACHINAE

Genus **Achaeus** Leach

Achaeus lacertosus Stimpson

(Plate I)

Achaeus lacertosus, Haswell, *Catalogue Austr. Crust.*, p. 3 (1882).
Henderson, *Trans. Linn. Soc. London* (Zool.), p. 341 (1893)
Alcock, *Journ. As. Soc. Bengal* **69**, p. 172 (1895) .
Barnard, *Ann. S. Afr. Mus.* **38**, p. 19 (1950).
Pillai, *Bull. Central Inst. Travancore* **2**, (1951).

Two female specimens were collected at Bombay, clinging to colonies of *Gorgonium.* The larger one measures:

length of carapace	.. 7.25 mm.
breadth of carapace	.. 6.25 mm.
length of rostrum	.. 0.60 mm.
length of first walking leg	.. 21.80 mm.

This species is distinguished by the smooth, triangular carapace with inflated branchial regions. The rostrum is short and bifid. The eyestalks are straight, and have no tubercle on their front margin. The walking legs are very long and slender, the first pair being more than three times the length of the carapace. The dactyli of the last two pairs are very strongly falcate (semicircular), and their inner margins bear recurved spines.

The specimens were heavily encrusted with algae and hydroid colonies, which necessitated cleaning in dilute sodium hypochlorite before the structure of the carapace and legs could be made out.

This species has been previously recorded from the Andamans, Palk Straits, Orissa, and Travancore, also from Australia, Persian Gulf, and South Africa. This is its first record from the Bombay coast.

Family *OCYPODIDAE*

Subfamily Ocypodinae

Genus **Gelasimus** Latreille

Gelasimus inversus sindensis Alcock

(Plate II)

Gelasimus inversus sindensis, Alcock, *Journ. As. Soc. Bengal* **69.** p. 356 (1900).
Gelasimus inversus, Barnard, *Ann. S. Afr. Mus.* **38,** pp. 94, 95 (1950).

Numerous specimens, of both sexes, were collected at Umarsadi. The measurements of an average sized male are:—

length of carapace	.. 10 mm.
breadth of carapace	.. 16 mm.
breadth of front	.. 3 mm.
length of larger hand	.. 23 mm.

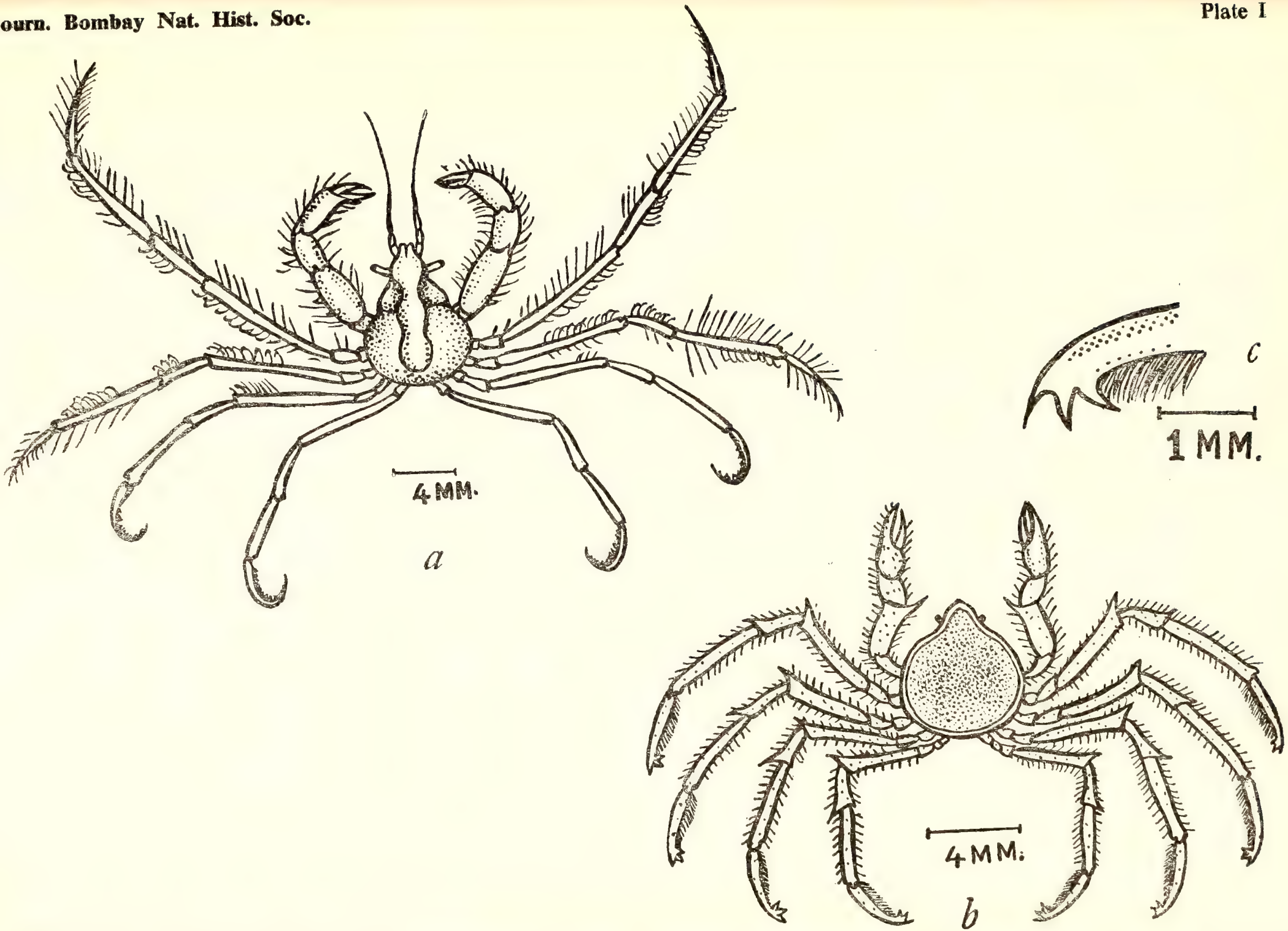
This subspecies closely resembles *Gelasimus annulipes* Latreille, but can be distinguished from the latter by the nature of the larger male cheliped. The arm of the chelipeds in *G. inversus sindensis* is trigonal with sharp edges, the upper edge rising into a distinct lobe or crest, and the distal end of the inner edge also forming a crest or blunt tooth. The upper border of the palm bears several longitudinal rows of granules. There is only one oblique granular ridge on the inner surface of the palm, running along the dentary edge of the thumb. The crest continuous with the lower border of the thumb present in *G. annulipes* is absent. The thumb is straight and has a simple tip.

Colour is similar to that of *Gelasimus annulipes.* The middle of the outer surface of the palm of the larger cheliped in the male has, however, a rosy tinge.

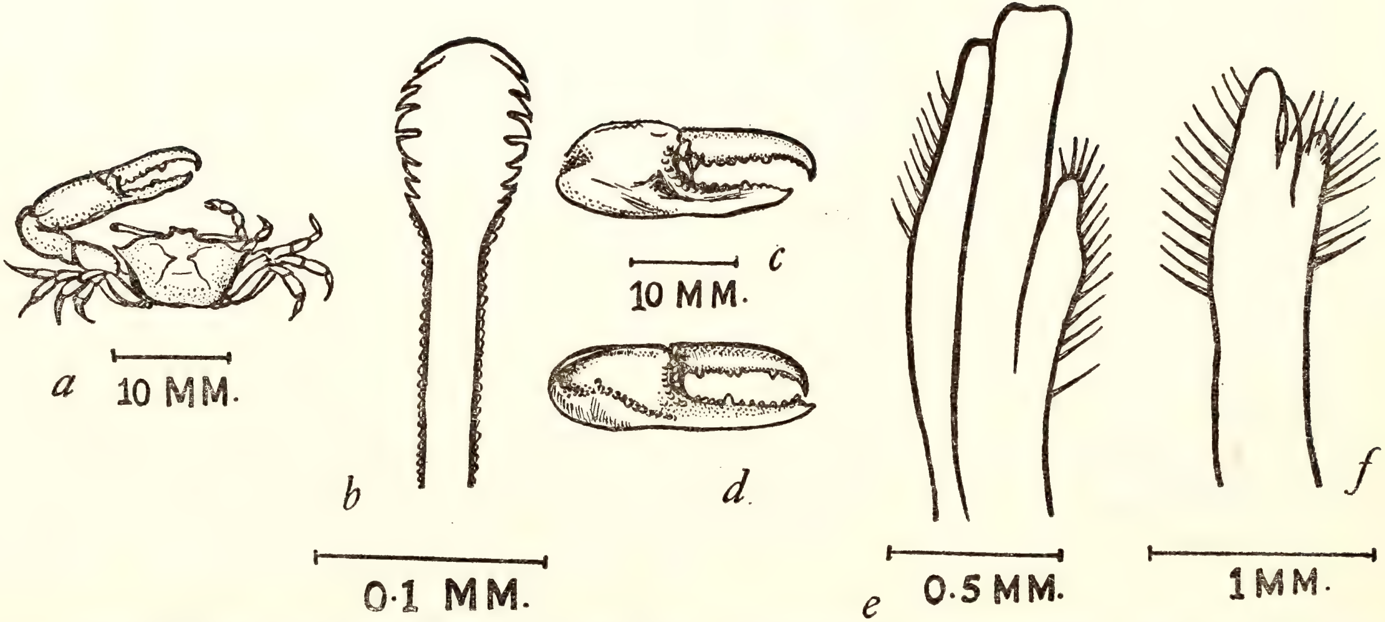
The anterior male abdominal appendages resemble those of *Gelasimus annulipes* in being bilobed at the tip. The larger of the two lobes which, in *G. annulipes* has a truncate-tipped bilobed appearance, has a single rounded tip with a groove. The smaller lobe on the side is situated nearer the tip of the appendage than in *G. annulipes.* The tip is more hairy.

Spooned hairs are present on the second maxillipeds. The 'spoon' consists of about eight rounded lobes on each side, continuing into hairs.

Barnard gives the distribution of *Gelasimus inversus* as Madagascar, South Africa, east coast of Africa, and the Red Sea, and Alcock has recorded the subspecies *sindensis* from Karachi. Hence this is the first record of this species from the Bombay Coast.



Achaeus lacertosus Stimpson : *a.* Dorsal view of crab. *Elamena sindensis* Alcock : *b.* Dorsal view of crab. *c.* Tip of walking leg, enlarged.



Gelasimus inversus sindensis Alcock: *a.* Dorsal view of crab. *b.* Spooned hair on 2nd maxilliped, front view. *c.* Cheliped of male. *d.* Cheliped of male *Gelasimus annulipes* Latreille. *e.* Tip of 1st left abdominal appendage of male *Gelasimus annulipes.* *f.* Tip of 1st left abdominal appendage of male *Gelasimus inversus sindensis.*

CORRECTION

My earlier remarks that *Gelasimus annulipes* Latreille and *G. marionis nitidus* Dana were new records for the Bombay Coast [Chhapgar, B. F., 1957, *JBNHS* **54** (3): 509; 510] are incorrect as these have already been recorded from Bandra, Bombay by Altevogt [1955, *JBNHS* **52** (4): 702-716]. I am thankful to Dr. Rudolf Altevogt, Münster University, for drawing my attention to these discrepancies.

TARAPOREVALA MARINE BIOLOGICAL STATION,
BOMBAY,
August 16, 1958.

B. F. CHHAPGAR, M.SC.

19. DIAGNOSIS OF A NEW SPECIES OF THE GENUS *BRANCHINELLA* SAYCE (CRUSTACEA : BRANCHIOPODA : ANOSTRACA) FROM SAMBHAR LAKE, RAJASTHAN*

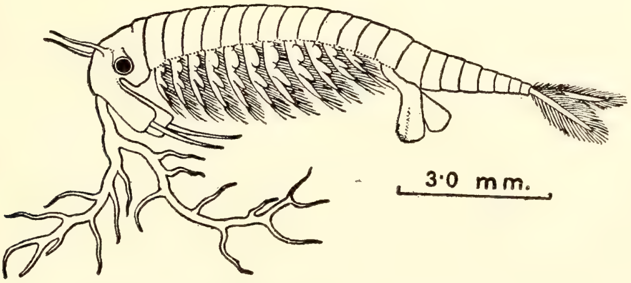
(*With three text-figures*)

A collection of branchiopod crustacea, made by Dr. B. Biswas of the Zoological Survey of India during November 1956, contained a new species of the anostracan genus *Branchinella* Sayce, which is being briefly described below.

Family THAMNOCEPHALIDAE

Branchinella biswasi,[1] sp. nov.

Male.—Generally resembling that of *Branchinella ornata* Daday[2] (Text-fig. 1). Frontal appendage more than twice as long as the



Text-fig. 1.—*Branchinella biswasi* sp. nov. ♂

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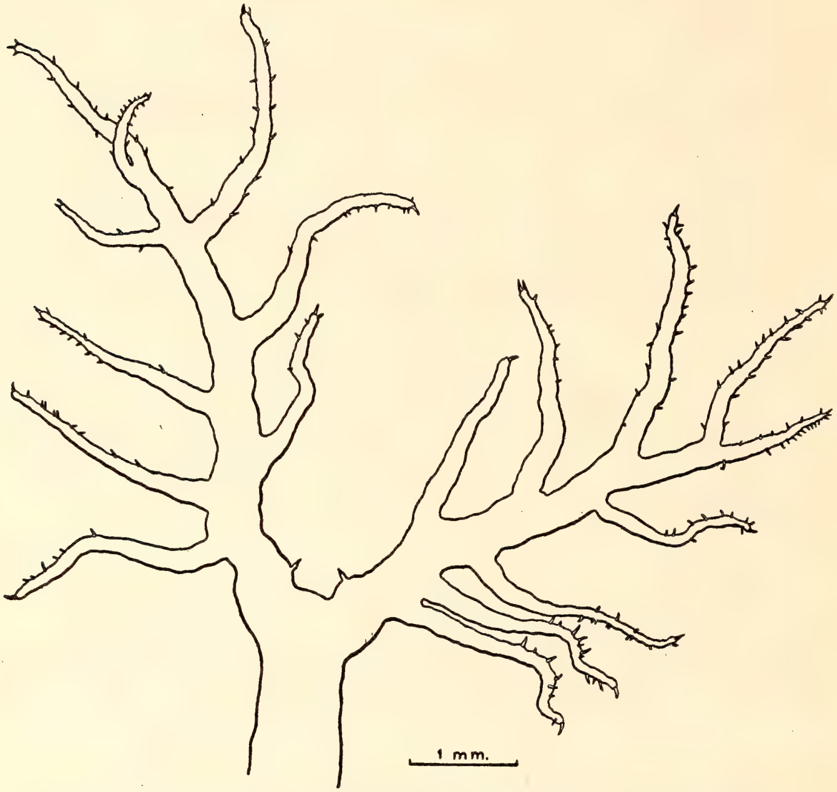
* Published with the permission of the Director, Zoological Survey of India.

[1] Named after Dr. B. Biswas who collected the specimens.

[2] Daday de Dees, E., (1910) : *Ann. Sci. Nat.* (9) **11** : 91-489.

second antenna, extending as far as the end of trunk when stretched back. Basal part, about a fifth as long as the entire appendage, thick and flabby; distal four-fifths bifurcated, each bifurcation with 4-6 secondary branches, irregularly arranged on each side; each secondary branch with scattered spinules more profuse towards the apex; apex tipped with 1, 2, or 3 spinules (Text-fig. 2).



Text-fig. 2.—*Branchinella biswasi*, sp. nov. Distal part of frontal appendage.

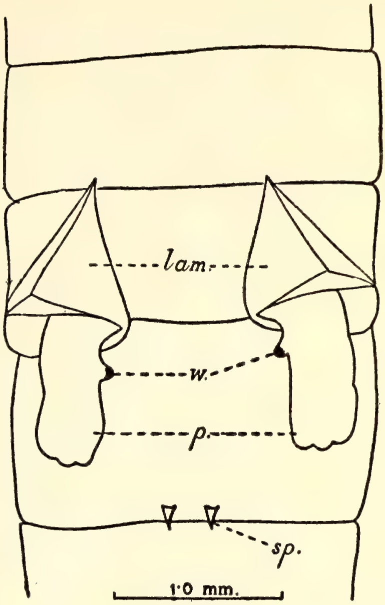
Endites 3-5 of all legs with 2, 2, 1, anterior setae respectively, praeepidodites non-serrate, entire, without any notch in the middle.

Penes with a triangular lamina frontal to each (Text-fig. 3, *lam.*); basal part with a small wart-shaped appendage (Text-fig. 3, *w.*), distal part with a complicated armature of spines as in *B. ornata*.

Third abdominal segment with a pair of median ventral spines on its posterior margin (Text-fig. 3, *sp.*).

All other characters as in *B. ornata*.

Female.—Resembling male. Second antenna with a rounded apex without an acute point. Ovisacs large extending back up to the middle or end of the sixth abdominal segment. No median ventral spines on the posterior margin of the third abdominal segment.



Text-fig. 3.—Ventral view of abdomen of male of *B. biswasi: lam.* triangular lamina frontal to penes; *p.* Penes (Not fully everted, so the distal part with armature of spines not visible.); *sp.* Ventro-median spines on the third abdominal segment; *w.* Wart-shaped appendage on the basal part of the penis.

Size.—Males 6.5 to 18.7 mm. in length. Females measuring 8.0 mm. to 25.5 mm.

Types—Holotype: ♂ (12.0 mm.), Regd. No. C3652/1, Zoological Survey of India.

Paratypes: 30 ♂♂ (6.5 to 18.7 mm.), 34 ♀♀ (8.0 mm.-25.5 mm.) Regd. No. C3653/1, Zoological Survey of India.

Type-locality.—Sambhar Lake at Nawa, Nagaur Distr., Rajasthan. Coll. Dr. B. Biswas, 16 Nov. 1957.

Remarks.—*B. biswasi* closely resembles *B. ornata* Daday recorded by Daday[2] (p. 269) from Kalahari in Bechuanaland and by Barnard[3] (p. 201) from Potchefstroom in Transvaal, both from south Africa. The important differences are presence in *B. biswasi* of a wart-shaped appendage on the basal part of penes, a pair of median-ventral spines on the posterior edge of the third abdominal segment, and the absence of a notch on the praeepipodites of legs.

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[3] Barnard, K. H. (1929): *Ann, S. Afr. Mus.* **29** : 181-272.

This is the second species of *Branchinella* from India, the other being *B. kugenumaensis* Ishikawa recorded by Linder[4] from Madras and *B. kugenumaensis* var. *madurae* Sanjeeva Raj[5] from Madura. The genus is now for the first time recorded from north India.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA-12,
September 18, 1958.

K. K. TIWARI

20. A NOTE ON VERY HEAVY FOULING OF COPPER SHEATHED HULLS OF NAVAL CRAFT AT BOMBAY

(*With a plate*)

Copper sheathing of ships' hulls has been considered to be the most successful method for prevention of marine fouling and attack of marine borers (1). The use of such protective sheathings has lost its popularity only with the development of suitable anti-fouling paints. However, even now copper sheet coverings are used to protect wooden hulls and also for other special reasons. Some of the Indian Naval craft with wooden hulls have their underwater portions covered with copper sheets and during dry-docking of such vessels at Bombay, it has been observed that generally the plates remain unfouled or lightly fouled with the worms (*Hydroides norvegica* Gunnerus). However, during the first quarter of 1958 a few of the craft, when dry-docked, were found to have been very heavily fouled. This was an unusual observation and the present account is based on data collected from three such vessels.

OBSERVATIONS

The fouling observed on the copper-sheathed hulls was found to be uniformly heavy at all regions of the hull and also at all depths, beginning from the portion just below the boot-top area. A significant feature was that the fouling was mostly due to different species of Bryozoans. A porton of the hull above the bilge-keel of one of the boats is shown in Fig. 1, which gives a clear idea of the intensity of fouling observed. Representative collections of the fouling were made and the organisms present were identified as follows:

Crisia eburnea Linnaeus: Colonies of this erect polyzoan were found in large numbers and the bunches had grown to a maximum

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[4] Linder, F. (1941): *Zool. Bidrag Uppsala,* **20**: 101-202, pl. i.
[5] Sanjeeva Raj, P. J. (1951): *Curr. Sci.* **20**: 334.

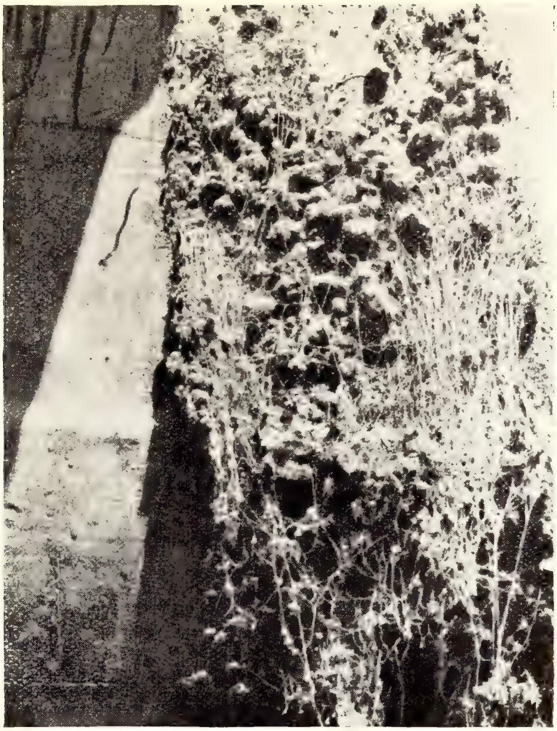

Fig. 1. Fouling of copper sheathing above the bilge-keel. (Portion on the left has been scraped, exposing copper plates.)

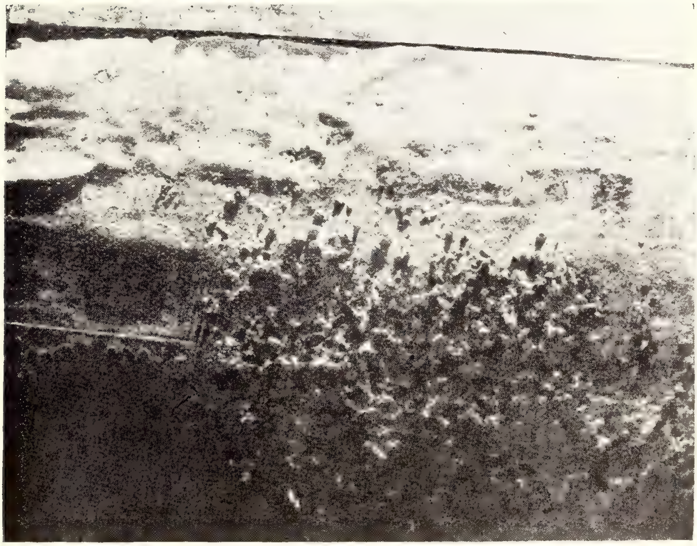

Fig. 2. Barnacle fouling on copper sheathing.

height of about 4 cm. These organisms were responsible for about 60% of the fouling settlement.

Zoobotryon sp.: These polyzoan colonies also were present in large numbers and comprised about 20% of the total fouling. The 'ropes' of the organisms are easily distinguishable in the photograph (Fig. 1).

Membranipora tenuis Desor.: This encrusting polyzoan was responsible for about 10% of the fouling. The colonies had grown to a maximum diameter of 3 cm.

The rest of the fouling present on the hulls was mostly due to tube worms of the species *Hydroides norvegica* and also a few barnacles of the species *Balanus amphitrite.* Free living animals like amphipods, small gastropods, etc. found among the polyzoan colonies have not been taken into consideration for this account.

One of the craft examined had a moderate settlement of barnacles (*Balanus amphitrite variegatus* Darwin and *Balanus amphitrite communis* Darwin) just below the boot-top area on one particular region (Fig. 2). This was the only occasion when barnacles have been found in significant numbers on the copper plates. No special reasons could be deduced for this occurrence.

The copper sheets had been fixed to the wooden hulls with copper nails and no contact with iron or zinc structures were noticed. Such contacts with other metals have at certain times been found responsible for fouling of copper (1). The heavy fouling observed in the present instance was not at all localised, but was, on the other hand, uniformly heavy throughout the under-water portions of the hulls. From the growth of the organisms concerned, it could be ascertained that the settlement had occurred within a period of three to four months. This particular season was a period of very heavy polyzoan fouling in Bombay waters, unlike previous years (2), as could be noticed from an analysis of data obtained from the examination of other ships and non-toxic panels exposed from a floating raft. It will also be of interest to mention that among the polyzoans thus collected during the period the most prevalent were colonies of *Crisia eburnea.*

REMARKS

From the observations described above, it appears that the extraordinary abundance of polyzoans in the Bombay waters during the period November-February 1957-58, was responsible for the heavy fouling of the copper sheathing which apparently had remained unfouled till that time. Fouling depends on the toxicity of the surface, sensitivity of the organisms concerned to the poison, and the seasonal abundance of the settling stages (1, 3). The polyzoan fouling described above could not be attributed to any decrease in the toxicity of the copper plates, or to any galvanic action. Further, these polyzoans had never been observed to settle on copper sheathing during previous seasons. The accumulation of corrosion products on copper has been quite usual and such plates, during earlier observations, had remained either unfouled or lightly fouled with tube worms only, after varying periods of service. Since the polyzoan fouling described above had occurred within a period of three to four months, and the sheathing had remained unfouled till that time, it is probable that biological factors like prolificity, gregariousness, etc., must have been the cause for the unusual phenomenon. It may be mentioned here that little only is known regarding the fundamental aspects of the action of copper on living organisms (4), and hence further investigations in this direction will be of value. The observations recorded above are of importance in the testing of antifouling surfaces also, because it is evident that during trials proper attention has always to be given to the biological peculiarities of the period. In order to collect further data regarding fouling of copper in tropical waters, the Laboratory has started a series of experiments with panels exposed on the floating raft.

Our thanks are due to Shri P. I. Thampy for his kind help in the identification of polyzoans.

NAVAL CHEMICAL & METALLURGICAL LABORATORY, NAVAL DOCKYARD,
BOMBAY,
July 17, 1958.

V. GOPALAKRISHNAN
V. V. KELKAR

REFERENCES

1. Marine Fouling and its Prevention. United States Naval Institute, 1952.

2. Ranga Iyengar, S., Gopalakrishnan V. and Kelkar, V. V. (1957) : Studies on Marine Fouling Organisms in Bombay Harbour. *Defence Science Journal*, 7, (4).

3. Pyefinch, K. A. (1948) : Biological Aspects of the Fouling Problem. *Journal of the Oil and Colour Chemists' Association* **31**, No. 341.

4. ——— (1950) : Studies on Marine Fouling Organisms. *Journal of Iron and Steel Institute.*

21. A NOTE ON A SPECIES OF *CISSUS*

(*With five figures*)

While investigating the origin and development of the tendril in *Cissus* I came across in Gujarat a species of *Cissus* resembling *C. quadrangularis,* but the specimen could not be compared with the reported species in Cooke's FLORA OF BOMBAY PRESIDENCY. It was identified as *C. quadrangularis* Linn. by Kew and *C. quadrangularis* (L.) Willd. by Indian Botanic Garden, Calcutta. Rev. Father H. Santapau informed me (11th Feb. 1956) that the specimen 'is near *C. quadrangularis* but it is not this species'. Recently I came across the same species growing in south India and the typical *C. quadrangularis* with its quadrangular stem was also found. When the specimens were again referred to Kew, the Director kindly informed me that Dalzell in 1857 pointed out that the plant called *C. quadrangularis* by Roxburgh, Wight, and Arnott appeared to be different from a similar plant found throughout Gujarat. The Gujarat plant has unwinged stems, ovoid fruits, trilobed or unlobed leaves, and tuberous roots, whereas the plant described by Roxburgh and others from Madras has winged stems, smaller globose fruits, unlobed leaves, and fibrous roots. I have observed both the types of plants in Gujarat and south India. I have also noted some anatomical differences between the two specimens. On the basis of my few observations Rev. Father H. Santapau recently (Nov. 18th, 1957) confirmed that 'it is clear that there are two species of *Cissus*':

1. *Cissus quadrangularis* Linn., identified by Dalzell as the plant of Gujarat, with rounded stem, etc.
2. *Cissus edulis* Dalz. the plant of south India, with square stems; the plant of Gujarat with square stems is the same as that of south India.

But I agree with Father H. Santapau that there is still need of more observations. I shall be grateful if the readers of this journal will kindly send me flowering and fruiting material of both the species.

I am grateful to Rev. Father Santapau, for kindly going through this note and helping me in identification. My thanks are due to the Director, Kew Gardens for help, Professor T. C. N. Singh, Professor and Head of the Department of Botany, for his interest and facilities, and to my students Shri T. Govindrajulu and S. Krishnan for the diagrams.

DEPT. OF BOTANY,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR (S. INDIA),
July 9, 1958.

J. J. SHAH

22. SOME NOTES ON THE GENUS *MUSSAENDA* LINN.

Species of the genus *Mussaenda* are a common and conspicuous feature of the flora of the Western Ghats from near sea-level to over 6000 ft. Gamble, in the FLORA OF THE MADRAS PRESIDENCY, distinguishes four species characterised by the enlarged white or cream calyx lobe—*M. glabrata* Hutch., *M. laxa* Hutch., *M. frondosa* Linn., and *M. hirsutissima* Hutch. In the FLORA OF BRITISH INDIA, however, these are all included as varieties of *M. frondosa* Linn.

An opportunity to examine specimens from varying elevations readily presents itself on the western outlet from Munnar to Alwaye in the northern part of the Kottayam District of Kerala. This road drops from about 5000 ft. at Munnar to some 300 ft. at Neriyamangalam on the Periyar River in a distance of 35 miles. The country traversed by the road was formerly covered with dense forest but has been extensively cleared in the past twenty years and there are now only small relics of the original cover. Munnar itself lies in a dissected plateau almost completely surrounded by hills rising to 6000 to 8000 ft. Within this plateau *Mussaenda* is very common up to about 6000 ft. and all the numerous specimens examined fall into *M. hirsutissima* Hutch. On the other hand specimens examined at the foot of the ghat road all agree with *M. glabrata* Hutch. At intermediate elevations, specimens agreeing with *M. laxa* Hutch. have been collected at the lower levels and with *M. frondosa* Linn. at higher ones.

These four 'species' from a series characterised by increasing hairiness, increasing density of the inflorescence, and decreasing leaf size with increasing elevation. They could be suitably considered as members of an 'ecocline' rather than as distinct species but there is obviously room for closer investigation of this interesting and well marked group.

MUNNAR P. O.,
HIGH RANGE,
KERALA STATE,
SOUTH INDIA,
July 16, 1958.

W. WILSON MAYNE, B.SC., M.I. BIOL.

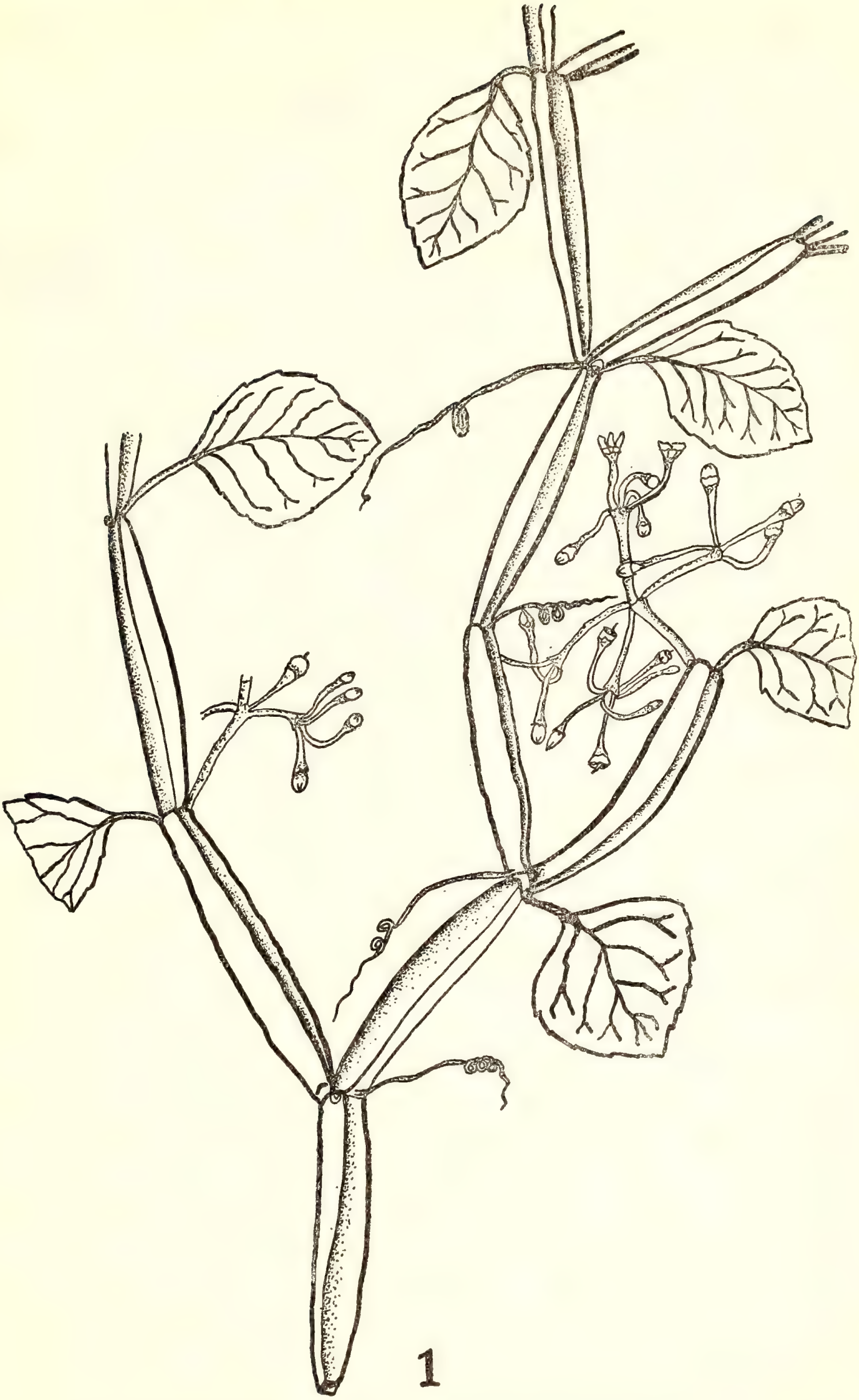

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Fig. 1. *Cissus quadrangularis* from South Arcot District, Madras. Note the typical quadrangular and winged stem.

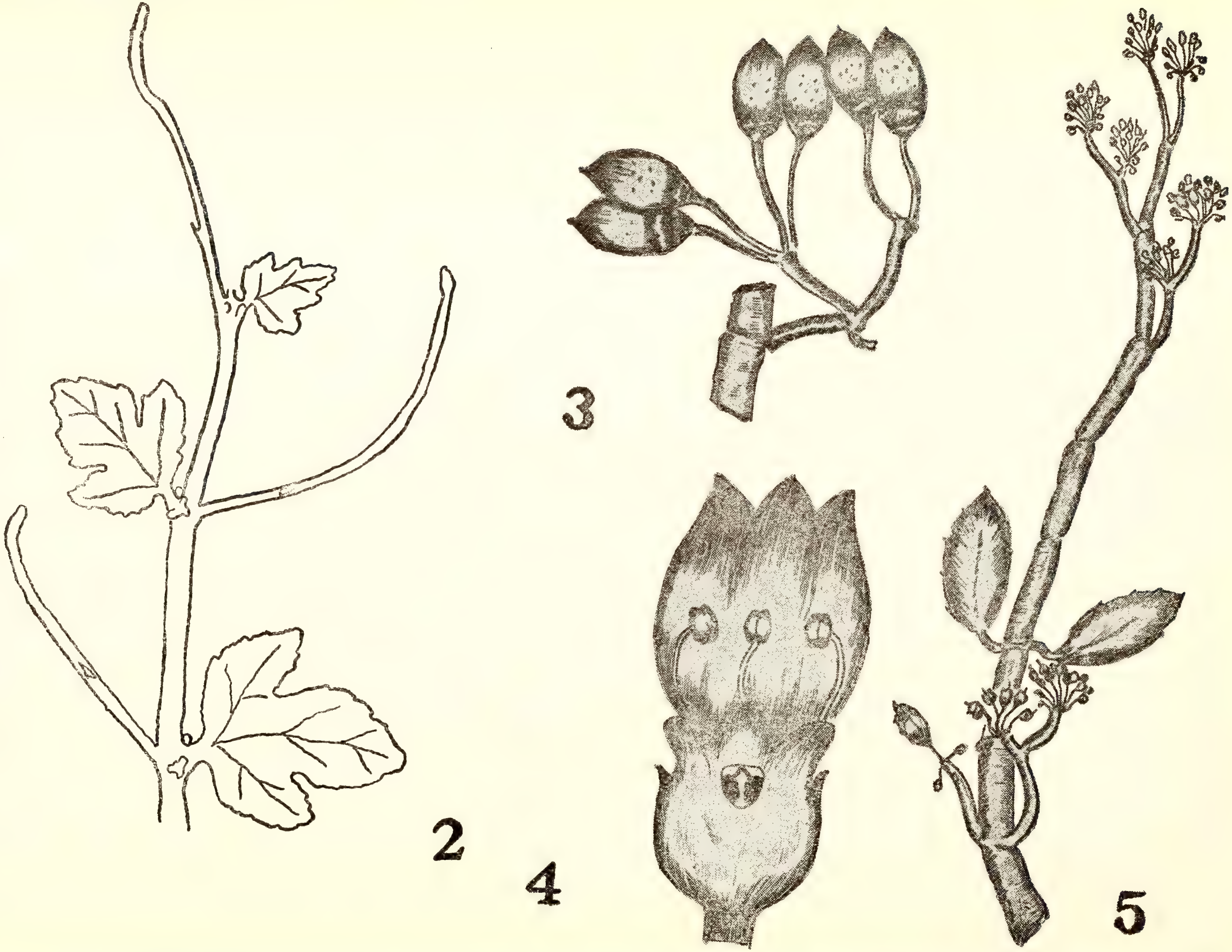


Fig. 2. *Cissus* species from Gujarat. Note the cylindrical stem. Fig. 3. Fruits of *Cissus* species from South Arcot District. Fig. 4. L.S. flower of *Cissus* species. Fig. 5. Flowering material of *Cissus* species from South Arcot District.

23. A RED OR ROSE VARIANT OF *POLYGALA ERIOPTERA* DC.

Those of our popular floras that mention the colour of the flowers of this plant state that it is yellow; on numerous occasions we have noted it to be so; but lately we have found plants with red or rosy pink flowers.

This is an annual monsoon plant that appears in grass fields or on grassy slopes some time about August; at first the plant bears a strong resemblance to some species of *Crotalaria,* from which, however, the structure of the sepals and of the fruits distinguish it clearly. The leaves are rather variable in shape and size, being obovate, or linear, or elliptic; flowers appear in few-flowered axillary racemes. Sepals 5, of which two are hyaline or colourless but for a strong green midrib. The petals are very irregular, somewhat united at the base, forming a sheath round the stamens; there are only 3 petals. Stamens 8. The fruit is a 2-seeded pubescent capsule enclosed within the two larger sepals; the seeds are smooth and hairy, with a distinct strophiole at the anterior end.

During the monsoon of 1957 this plant was collected repeatedly on Pavagadh Hill, 29 miles NE. of Baroda; during August and September the flowers were of the usual yellow colour; on October 2nd, 1957, we collected some plants with pink or rosy or reddish flowers, the colour remaining even when the flowers began to fade.

We have checked our plants with the descriptions given in our floras; the specimens have been confirmed in Blatter Herbarium as being *P. erioptera* DC. The colour of this species seems to be recorded here for the first time as being other than yellow.

We wish to record our gratitude to the Rev. Fr. H. Santapau of St. Xavier's College for helping with the identification of the plants and going through the MS. of this note.

DEPT. OF BOTANY,
M. S. UNIVERSITY OF BARODA,
BARODA,
July 5, 1958.

V. G. PHATAK, D.SC.
G. M. OZA, M.SC.

24. *CRYPTOSTEGIA MADAGASCARIENSIS* BOJ.— A NEW RECORD FOR BOMBAY

(*With one plate*)

In our intensive field studies on the family Asclepiadaceae we have often come across a plant that for a time troubled us; it seemed to agree to some extent with the common *Cryptostegia grandiflora* R. Br., but there seemed to be too many differences that called for an explanation. We have finally identified our problem plant as *Cryptostegia madagascariensis* Boj., which has turned out to be a new record for Bombay or even possibly for India; we do not find any description of the plant in our common floras.

The two plants can be distinguished by the following key:

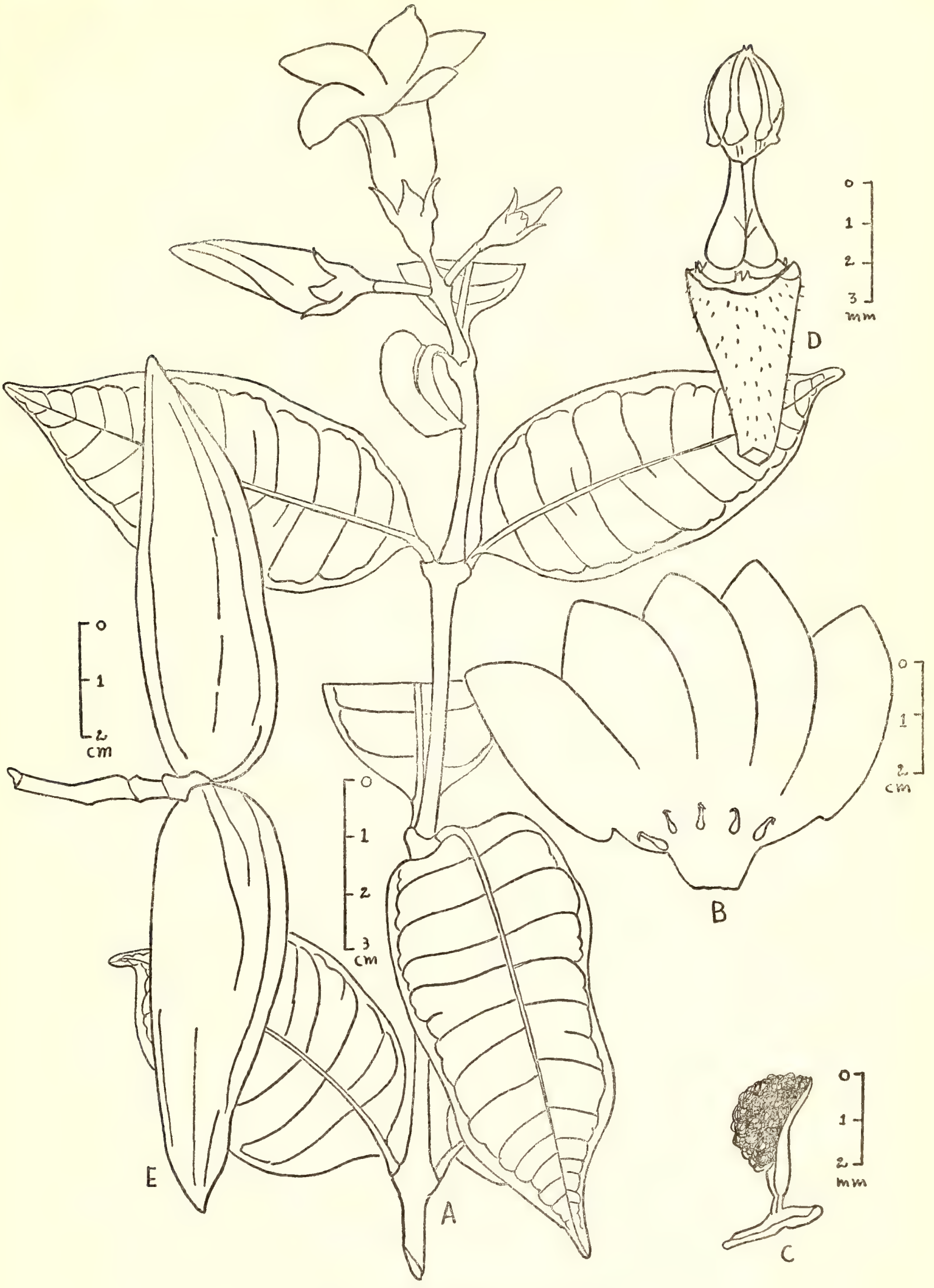
Corona lobes cleft into two long, filiform segments; each follicle up to 12 cm. long	... *C. grandiflora*
Corona lobes entire, subulate with incurved tips, each follicle up to 7 cm. long	... *C. madagascariensis*

In passing it may be remarked that *Cryptostegia, Hemidesmus,* and *Periploca* have hitherto been placed in the family Asclepiadaceae; Schumann, in Engler and Prantl's *Die Natürl. Pflanzenfam.* 1895, placed these genera under the subfamily Periplocoideae; A. Bullock, in *Kew Bull.* 1956, erected the family Periplocaceae for the group. In our opinion there is ample justification for this separation into a family.

We give herewith a description and some notes on our new record:

Cryptostegia madagascariensis Boj. Hort. Maurit. 212, 1837; Decne. in DC. Prodr. 8 : 492, 1844 ; Bot. Mag. t. 7984, 1904.

An erect, suberect, or climbing *shrub*, 1.5-2 m. high. Branches terete, swollen at the nodes, lenticelled and warted. *Leaves* opposite, decussate, exstipulate, petiolate, coriaceous, 3-4 × 1.5-2 cm., ovate or elliptic-oblong, shortly acuminate at the apex, subacute or rounded at the base, glabrous on both sides, dark green and glaucous above, paler beneath; lateral nerves 9-12 pairs, coming out at nearly right angles to the midnerve, and uniting into a clear intramarginal nerve; petioles 5-8 mm. long, compressed, glabrous, glandular in the axils. *Flowers* showy, white tinged with rose or purple, in few-flowered, terminal dichotomous cymes; peduncles 1.8-2 cm. long, compressed, glabrous, lenticelled; bracts 6 × 2 mm., caducous, linear, acute, puberulous; pedicels 1 cm. long, stout, terete, glabrous or nearly so.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Cryptostegia madagascariensis Boj.

A. Flowering branch ; B. Dissected corolla showing corona ; **C.** Pollen mass ; **D.** Pistil ; E. Fruit.

Calyx lobes deeply divided, 1.2×0.4 cm., lanceolate, acute, glandular within, glabrous outside, ciliolate at the apex. *Corolla* funnel-shaped, 6 cm. across when fully open; tube short and narrow below, opening into a subcampanulate throat; lobes 3.2×1.8 cm., oblong, acute, overlapping to the right, glabrous but velvety to touch. *Corona* corolline, near the base of the throat, of five subulate lobes, which are 6-7 mm. long, with incurved tips. *Filaments* short, subconnate at the base; anthers sagittate, adnate to the stigma; connective produced into apiculate-deflexed tips; pollen masses granular; translator lanceolate. *Ovaries* two, glabrous, many-ovuled; style short, stout, glabrous; style apex dome-shaped. *Follicles* in pairs, divaricate, woody, 3-angled, glabrous, 7×2 cm. Seeds 6×2 mm., ovate, glabrous; come 2.5 cm. long silky white.

Flowering: September to April.

Fruiting: January to April.

Records from Bombay examined: KONKAN: Bassein, *Santapau* 21204; *Irani* 2187; Andheri, *Irani* 1662; Santa Cruz, *Dhruna,* Sept. 1950; *Bole,* March 1950; Bombay, *Irani* 731, 1418, 1745. DECCAN: Shivajinagar, *Irani* 181. All these specimens are kept in Blatter Herbarium.

Distribution of this plant: The plant is native in Madagascar, whence it has been cultivated in tropical gardens generally; in Bombay it is often seen as a hedge plant, and seems to have established itself as an escape from gardens in Bombay and Salsette Islands and near Poona. It is a good hedge plant.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
September 20, 1958.

H. SANTAPAU, S.J.
N. A. IRANI, M.SC.

Gleanings

Nature's anti-sepsis

The maggots of the bluebottle and some other flies are like the spider in that they can eat no solids. They too emit a fluid, which dissolves the meat and turns it into a putrefying liquid as they go along. In a recent book, I mentioned this fact and, impressed by the quick-acting potency of this fluid, idly suggested that, some time perhaps, a use might be found for it. This brought me a letter from a surgeon, part of which I will quote:

'. . . you refer to bluebottle grubs exuding a liquid which you think might have some use. You may like to hear of one use which I believe is now recognised.

'During the first World War I was surgical specialist at a Casualty Clearing Station which was posted first behind the salient and for the rest of the war on the Somme. We were usually five to ten miles back from the line and it often happened that we did not get the casualties for two or more days and the numbers were so great that some did not get attended for another day. The soil of the salient, and the Somme, was teeming with tetanus and gas gangrene organisms, and if wounds could not be excised and cleaned up soon after infliction the chances were that they rapidly developed gas gangrene, often with fatal results. Perhaps you have come across such conditions, but if not I may tell you that a gangrenous wound is most unpleasant both to nose and eye.

'We found that many wounds on arrival at the C.C.S. were swarming with maggots and we soon noticed that when the maggots were cleared away a red, healthy, granulating surface appeared where they had been and that the men were not so ill as one would have expected. We therefore took to exposing some of the wounds to the flies and got them fly-blown and the results were often good, but the question always arose as to whether one was justified in holding up operation while the flies did their job. The operation consisted of very complete excision of the wound and all infected tissues. Anyway there is no doubt that the maggots did a very good job and I believe the pathologists did some research into the subject later on, but I did not hear much more about it.'

Extract from John Crompton's LIFE OF THE SPIDER.

Rena fishing in the South Sea island of Raroia

Bengt Danielsson, a member of the famous Kon-Tiki expedition, who afterwards returned to the island of Raroia, gives an interesting account of *rena* fishing on the island in his book THE HAPPY ISLAND:

'We hurried down to the shore . . . Fifty yards from the land a white cloud of shrieking gulls hung over a big black patch in the water. It was clearly a gigantic shoal of fish. Despite the savage attacks of the birds the black patch gradually increased in size; in half an hour's time it was as large as a market-place. The time seemed to have come to start fishing, and Teka gave orders for preparations to be made. To our great astonishment the whole crowd dashed off at once, and in a little while we were alone with Teka. . . . We did not need to wait long before the first to go came back with large bunches of palm leaves under their arms. By degrees the rest of the villagers returned, and each of them carried at least five large palm leaves.

'Now you'll see how we make a *rena,*' said Teka, and slit a palm leaf in two along the central nerve. 'A *rena* is much better than a net for catching *komene.*'

'Then he laid one half on top of the other and took a new leaf. All round us all the Raroians were slitting palms leaves in two in the same way. In a little while the whole beach was covered with neat little piles, each of five half-leaves. The next stage of the work followed immediately. Our friends collected in small groups and began to fasten the bundles together with fibres and palm leaves. Then they joined the bundles lengthwise. As soon as a length reached about thirty feet a man caught hold of each end of it and began to wring it much as one wrings water out of a sheet. The natural consequence was that the lobes of the leaves pointed in all directions so that the length looked more like a garland, or a tinsel band on a Christmas tree, than anything else. When all the different groups had done this they began to splice the lengths together to make a single garland, which when completed was some 500 yards long. At last the fishing could begin!

'Two of the strongest men took hold of one end of the palm garland, and the rest of the Raroians placed themselves along it at equal intervals. We hastened to follow their example. We waded slowly and cautiously out into the shallow water and approached the shoal of fish. The garland of leaves closed slowly about its prey like a gigantic green snake. We had soon encircled the leaping mass of herring-like fish. The air was still full of shrieking, fluttering gulls, which followed us closely as we began to wade back to the beach. When we had got into water about four inches deep and had drawn the circle of leaves together to half its original size they reluctantly disappeared.

'A few yards from the beach we stopped. The fish were now packed so tightly that they could no longer move, and clearly nothing remained to be done but to scoop them up. To make this work easier the women picked up palm leaves which had been left over and in a twinkling plaited together handly baskets, while many of the men took off their hats and used them as scoops. Half an hour later a long row of shining silver fish lay on the beach, and the distribution could begin . . . When they had at last finished we were able to take no fewer than twenty-one fish each!

'I need hardly add that all our friends ate up every single fish the same afternoon and next day were looking out hungrily for fresh shoals of *komene*. They did not need to look in vain, for there were plenty of them that day and the days that followed. My notes show that for over two months we made at least three *rena* expeditions a week, and each time the catch was between 1,000 and 3,000 *komene*.'
—Bengt Danielsson in THE HAPPY ISLAND—KON-TIKI ISLE.

Report on the Birth of a Wild Elephant

I was at the Kudasilawal lagoon about 8 a.m. one morning when nine elephants came out of the jungle into the open space around the lagoon. I climbed one of the rocks there and waited. One of the elephants, the cow which afterwards gave birth, went down on its knees and gently lay down on its side with its legs outstretched, remaining in that position for several minutes. The other eight elephants stood around her, caressing her all over her body with their trunks. The cow then rose to her feet, walked away a few paces, and lay down again as before. The other elephants, save one, went into the surrounding jungle; this one remained standing by the cow. More minutes passed and the cow then rose again, walked a few paces away and again lay down, and this time turned over to the opposite side, pivotting on her spine. It remained like this for about ten minutes and then rose once again, went a few paces and again lay down. This time it got up almost immediately after it lay down. As it rose, I noticed a pale, pink coloured bag about two feet in diameter, protruding out of its genitals. With the protruding bag in this position, the cow paced to and fro, apparently quite normally, for about ten minutes, and then the bag burst open and a watery fluid poured forth from it. Just at this time, the other elephant, which had remained with the cow throughout, strolled away and joined the rest of the herd which was all the time in the jungle close by. Several minutes after the water-bag burst open, the cow again lay down. It was now about 9 a.m. The cow lay still in her prone position, only moving and tossing her trunk around, but uttering no sound, not even a groan, for about half an hour. Her abdomen was rising and falling at regular intervals and she appeared to be heaving. Two elephants from the herd in the jungle walked slowly up to the prostrate cow, felt her with their trunks in the region of the genitals, and then returned to the jungle.

Shortly afterwards, the cow stretched out her hind legs wide apart and without any noticeable signs of strain, the head and forelegs of the calf appeared. Immediately after, the cow rose to its feet and then again, in a few seconds, went down on its knees and lay down. Almost at once the calf was dropped and the cow immediately rose up and walked away for about ten paces. At this time the cow bled profusely from the genitals. Having gone this distance, the cow again lay down on its side and kept tossing and turning over from side to side. The calf lay on the ground where it was dropped and was wriggling about. It was covered all over with what appeared to be a slimy liquid. About fifteen minutes later, one of the elephants with the herd came up to the calf, raised it with its trunk about four feet clear off the ground, and then gently placed it back on the ground. This elephant then made a loud, rumbling noise, and all the other elephants in the herd came out of the jungle, trumpetting and making various noises, and approached the new born calf. Each one of them in turn moved the calf about with its trunk and feet and threw sand on the calf. This went on for about half an hour at the end of which the calf stood up, quite dry and steady on all fours. The calf, after rising, tried to suck milk from other elephants. Its mother, which continued to remain lying down and tossing about for several minutes longer, then dropped the afterbirth while lying on the ground. She rose immediately afterwards, picked up the afterbirth and ate a portion of it. She tore a part of it to pieces and flung it away and also trod on portions of it. The afterbirth appeared like a large sack in a portion of it, with elongations similar in appearance to the tentacles of an octopus. Some portions of the afterbirth were fleshy, while others were like lumps of ‘nerves’. The whole was coloured purple in some parts, in others pinkish or reddish. The baby elephant did not appear to have a umbilical cord. It was about 2½ feet high and its little trunk was about twelve inches long. About 15 minutes after the cow dropped the afterbirth and did away with most of it, she walked up to the calf which was now in the midst of the herd. The cow, on reaching her calf, trumpetted, lifted the calf with her trunk and took it away from the other elephants. She then placed the calf on the ground. The calf was now trying to suck milk from its mother. The cow went down on her knees and rested her head on the ground. The calf then reached for the breasts and sucked off both breasts for a considerable time. The cow then rose, picked up the calf in her trunk, poised it high up to her chin, and walked away in the centre of the accompanying herd into the jungle. I then came down from the top of the rock.

I found the ground where the cow was lying smeared with blood and a slimy fluid. I cut a piece from what was left of the crushed afterbirth. The portion I cut contained blood and appeared to consist of tubes, each about two inches in diameter and two feet long.

Game Guard W. L. A. Andris of Yala Range, Ceylon, in Administration Report of the Department for Wild Life, 1953.

[Three other eye-witness accounts of the birth of an elephant calf are published in previous volumes of the *Journal* (Tutein-Nolthenius, 1935, **38**: 183; Morris, 1936, **38**: 613; Vincent, 1946, **46**: 183) to which reference is invited.—EDS.]

CORRIGENDA

Vol. 54, No. 3, August 1957

p. 733, line 7 : For ‘ intermaxillary teeth ’ please read ‘ intermaxillary plate ’

line 9 : For ‘ intermaxillary place ’ please read ‘ intermaxillary plate ’

p. 735, line 7 : For ‘ Hegord ’ please read ‘ Hefford ’

lines 10 to 13 : For ‘ In addition .... *M. talabonoides*.’ please substitute ‘ Pillay (1948) observed the species in commercial quantities in Kathiawar coast. Observations made on the numerous hauls taken by the trawlers along the Kathiawar coast showed occasional occurrence of this species, although the major portion of the eel catch comprised of *M. talabonoides*.’

p. 739, line 11 : For ‘ long line catches ’ please read ‘ bag-net catches ’

‘ References ’, 1st line : For ‘ The Studies on the .... ’ please read ‘ Studies on the .... ’

Vol. 54, No. 4, December 1957

p. 971, lines 7 to 9 from bottom please read as : ‘ ranges from 6.5 to 8.5 showing that the soils are mostly alkaline in nature.’

p. 972 : In the table of ‘ Analysis of Soil Samples ’ please read the last two columns as under :

pH	Remarks
7.5	Alkaline
7.0	Neutral
8.5	Alkaline
7.0	Neutral
7.0	,,
7.5	Alkaline
6.5	Acidic
7.5	Alkaline
7.0	Neutral
8.5	Alkaline
8.5	,,
8.0	,,

Vol. 55, No. 1, April 1958

p. 64, line 15 : For '*Chela* (*Allochella*) *fasciatus*' please read, '*Chela* (*Allochela*) *fasciata*'.

Vol. 55, No. 2, August 1958

p. 357, line 24 : For 'A FIELD GUIDE TO BIRDS OF BRITISH ISLES AND EUROPE by Guy-Mountfort and Roger Peterson', please read 'A FIELD GUIDE TO THE BIRDS OF BRITAIN AND EUROPE by R. Peterson, G. Mountfort, and P.A.D. Hollom'.

p. 373, line 6 : For the word 'atokous' please read 'epitokous'

p. 374, lines 7 and 8 : For '*Armandia Leptocirris*' please read '*Armandia leptocirris*'

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